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GEORGE ELIOT ON MENTAL DECAY.

By Richard A. Proctor.

"The old man says, 'Son, I have swallowed and digested the wisdom of the past.' The young man says, 'Sire, I proceed to swallow and digest thee, with all thou knowest.'"—*O. Wendell Holmes.*

ALTHOUGH none of the unpublished letters relating to the views of George Eliot on old age, and on mechanism in life and thought, have been forwarded to me, I can gather from answers by my friend the acting editor that several readers regard those views as objectionable from a religious or theological point of view. For instance I find the editor at p. 14 reminding a correspondent that George Eliot's dicta were put forth in these columns "as those of a dead woman of the highest literary ability, and of almost world-wide fame (or notoriety)" [!],—he might have said of a dead woman who stands as high above all others living or dead, in literary and philosophical ability, as Shakespeare above all men,—"and neither as arguments nor with any expression of approval. I suppose," he proceeds, "that if I reproduced a conversation here in which Spinoza was an interlocutor, you would accuse me of admitting evidence for Pantheism! You, however, yourself" (he is addressing "H. R. B.") "did unquestionably trench on theological ground, inasmuch as yours was a categorical contention for positive miraculous interference in explanation of a phenomenon of nature."

Well, now, let any want of definiteness as to my own aim and purpose in quoting George Eliot's views be corrected. I quoted them as for the most part the views which in these our times *must* be taken respecting the mechanism of life and thought; as in agreement with all that has been learned about cerebral action and physiological laws; as assuredly needing no approval, because no one who has studied the matter with any degree of care, and with power of forming a just opinion on any subject, can doubt that those views are just; and finally as relating to a matter of purely scientific interest. The idea that such inquiries are to be regarded as relating to matters theological, because this or that person is disposed to deduce such and such inferences in regard to theological questions, is simply absurd. Every one sees the absurdity when the flat-earth man tells us that the doctrine of terrestrial rotundity is irreligious. And I suppose most people would recognise the absurdity of criticism on a treatise upon Epilepsy, that the phenomena described were in former times regarded as due to possession by devils, and have been so described in passages associated with the theological doctrines of Christianity, Judaism, Mahomedanism, Buddhism, and other religions. It is fully as absurd to regard the subject of George Eliot's remarks, introduced among other scientific matter into these columns, as related to religion or theology,—though of course they can be connected, like every earthly thing, with religious matters. Two steps will take the religious enthusiast of the exuberant type (whose religion somehow one always doubts) from Consols to the Gospels. But KNOWLEDGE is not meant for such persons.

I look over everything said by George Eliot and Mr. Lewes in the conversation quoted, and excepting her remark that the moon is a material mirror (which is inexact, but probably Buchanan, rather a careless reporter I imagine, altered what she said) I find absolutely nothing which can even be questioned, far less anything which I should myself oppose. Her remark that the phenomena of old age afford a strong argument against the *popular conception* of a personal immortality is too guarded to be questioned,—and asserts too little to be conceivably offensive even to the weakest brethren. For my own part I regard even the doctrine of a future life as open to scientific discussion, and not necessarily a religious doctrine at all.

But I remember that when Dr. Holmes was writing on the "Mechanism of Mind and Morals" he found it necessary to make a concession to the timidity of those who cannot separate the scientific study of his subject from certain religious ideas which they have been accustomed to associate with it. "We need not," he points out, "be frightened from studying the conditions of the thinking organ in connection with thought, just as we study the eye in its relation to sight. The brain is an instrument, necessary, so far as our direct observation extends, to thought. The 'materialist' believes it to be wound up by the ordinary cosmic forces, and to give them out again as mental products;* the 'spiritualist' believes in a conscious entity, not interchangeable with motive force, which plays upon this instrument. But the instrument must be studied as much by one as by the other; the piano which the master touches must be as thoroughly understood as the musical box or clock which goes of itself by a spring or weight. A slight congestion or softening of the brain shows the least materialistic of philosophers that he must recognise the strict dependence of mind upon its organ, in the only condition of life with which we are experimentally acquainted. And what all recognise as soon as disease forces it upon their attention,

* "It is by no means generally admitted that the brain is governed by the mind. On the contrary, the view entertained by the best cerebral physiologists is that the mind is a force developed by the action of the brain." (Dr. Hammond, in the *Journal of Psychological Medicine*, which he edits.) It will be observed that while George Eliot evidently inclined to this view, it is a matter of no moment so far as the supposed relation of her subject to religion is concerned, whether one view or the other is adopted. The quality of music as such—that is the beauty of its melody and the perfection of its harmony—cannot be regarded as depending on the music being drawn forth automatically or otherwise from the instrument which renders it.

all thinkers should recognise, without waiting for such an irresistible demonstration."

I have given so many examples, in my essays on mental phenomena, of entire change of mental and moral character resulting from injury to the brain or disease affecting it, that it should hardly be necessary for me to say that I myself believe unhesitatingly in the dependence of each man's nature on his physical condition. But I will cite a case which seems to me so striking and instructive that even the most prejudiced—those who *will* see some theologically dogmatic application of every scientific doctrine—can hardly misunderstand its significance.

Two brothers showed, at the age of five and ten respectively, a singularly close attachment. When the elder was sent to school, both children were so unhappy, and became so ill, that, to save their lives, their father brought the elder home again, and a little later sent both to one school. The boys made rapid progress, and "their parents' hearts were filled with thankfulness" by the news they received about the lads' moral and mental qualities. Suddenly, the schoolmaster had to announce an entire change in the character of the elder brother. "He had begun to exercise a very unreasonable and tyrannical authority over the younger; he had been repeatedly punished for it; but although he always promised amendment, and could assign no cause—reasonable or unreasonable—for his conduct, he soon relapsed into his usual habits." The father, after due inquiry, inflicted severe corporal punishment on the elder brother, and confined him to his room for some days with nothing but bread and water for food. The lad earnestly promised amendment. But on his return to school, he presently resumed his misconduct. At last, the father took him away from the school. Severe punishments, long incarceration, and the censure of all his relatives had no effect in changing his disposition. His hatred for his brother increased, until at length the life of the younger was no longer safe from the fury of the brother who had once loved him so well, had "watched him with a kind of parental solicitude, keeping a vigilant eye on the character of the boys who sought his society, and admitting none to intimacy of whom he did not entirely approve!"

A boy who had been exemplary in all his conduct, and actually remarkable for the warmth of his brotherly love, had thus become a monster of cruelty towards his brother who still loved him so much that he would say with streaming eyes, "He might beat me every day if he would but love me; but he hates me, and I shall never be happy again."

But the boy was changed in other ways. At the age of fifteen he was seized by a violent passion for a lady more than forty years old and the mother of five children, the eldest older than himself. There was no depravity about this passion; but its intensity was astounding. His paroxysms of fury when he could not see her became frightful; "he made several attempts to destroy himself; yet in the very torrent and whirlwind of his rage, if this lady would allow him to sit down at her feet and lay his head on her knee, he would burst into tears and go off into a sound sleep, wake up perfectly calm and composed, and looking up into her face with lack-lustre eye, would say, 'Pity me: I can't help it.'"

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When, however, a little later, the boy was manifestly becoming idiotic, care for his mind led to a sudden "conversion" which had not rewarded and was not likely to reward the anxiety with which his moral character had been so long viewed. A doctor examined the boy's head, and found a place where the skull was slightly depressed. "The indication is vague," he said, "and we should not be justified in performing the operation for removing a piece of the bone by the trephine, were it not that in this case no harm can be done; the boy must soon die, whether or no." The trephine was applied, and on the inner surface of the part of the skull thus removed, a long spicula of bone was found which had been growing so as to pierce the brain. So soon as this piece of bone had been removed the boy became himself again; his love for his brother returned and his passion for the lady disappeared.* Can it be denied that such a case as this affords the strongest possible argument against the *popular conception* of personal immortality? For here were two entirely distinct personalities,—a kind and gentle one, a brutal and wicked one. Which of these was to be immortal? According to the *popular conception*, as the tree fell it was to lie, for ever. Did the trephine decide between an infinity of happiness and an infinity of misery? Does not a similar objection arise against the *popular conception* of immortality, when the man who has lived a goodly, kindly, and honest life, till old age, becomes weak, spiteful, and dishonest through some decay and degradation of brain substance,—and so dies?

And now, duly to show the real connection, or want of connection, between George Eliot's remarks and religion, I propose to present a conversation similar to that reported by Mr. Buchanan, but with a change of subject. I will call the interlocutors simply A, B, and C; the subject is the wearing out of musical instruments, and "the following suggestive remarks are interchanged":—

A. Were it not better that the instrument whose tones we have learned to love should be destroyed while as yet it has not lost its excellence, than that it should be suffered to grow so worn and old that its tones can cause but discomfort and annoyance?

B. You are right. It is but sentiment which makes novelists speak of the charms of worn-out spinnets and harpsichords. There is nothing so distressing to the musician as the slow and certain wearing out of what has once been a fine instrument.

C. But is not the softening, though it be the weakening, of the tones, beautiful too?

B. Apart from fanciful fallacies not at all. Your favourite poet has correctly spoken of the decay of an instrument as ruinous, of the "rift within the lyre" which, slowly widening, in the end must silence all. Old instruments (even the violin when *really* old) are simply distressing.

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C. You offend my musical sense. Can the noble music of Beethoven, Mozart, Rossini, and their fellows, be regarded as mere instrumental products?

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I MUST, in the first place, ask my readers to correct an error in my last paper. The figure given belongs to *Misus cerasi*, the cherry aphis, not to *M. ribis*, the currant one, which I was watching when I made the mistake. The cherry fellow is large and black; the currant one green. I should not again refer to the Aphis tribe but for wonderful accounts in the newspapers of swarms of so-called "flies." Exaggeration in these matters is common in "the big gooseberry season;" but the following from the *Sussex Daily News* of July 23 may not be far out:—

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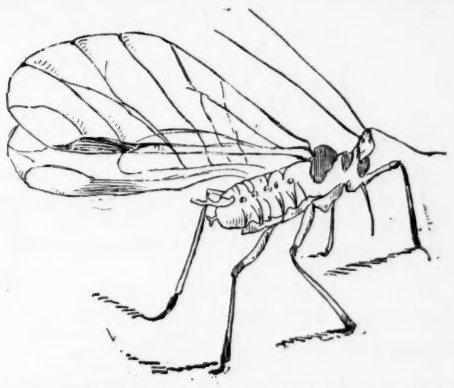

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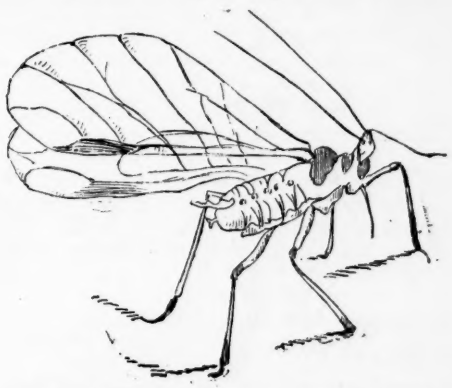

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assailants, and none have appeared since. It is remarkable that although aphides of one species do not seem absolutely confined to one plant, they may swarm for weeks on the one they like best, and not one will go to another tree or plant almost in contact with it. With regard to their various enemies, they unfortunately often fail to appear when they are most needed, and on occasion of a recent search in a kitchen-garden, where many sorts of aphis were enjoying themselves on currant, plum, apple, and other trees, not a single useful opponent could be found. It is interesting to pick off from any leaves the cast skins of any of these creatures, and note the extent of the moulting process. The outer layer of the cornea of the compound eyes comes off like a pair of spectacles, and the integument of the antennæ, and even that of the fine, piercing bristles is also shed. The piercing bristles deserve minute study. When in use, their action must differ from the whip-like cilia of the monads which are lashed about in the water. The slender piercers of the aphides have to be inserted into tissues of considerable resistance, and it is wonderful how those of the *Stomaphis quercus* can be thrust into oak bark. I have not seen it, but take the figure from Buckton's admirable work. An examination of many aphis' bristles with powers up to an oil immersion 1-12, lead me to think the secret may be in their being hollow, so that they can be stiffened by the injection of some fluid. It is obvious that those of the oak aphis would be useless as whips.

Fig. 2.—The pupa from which it was excluded.

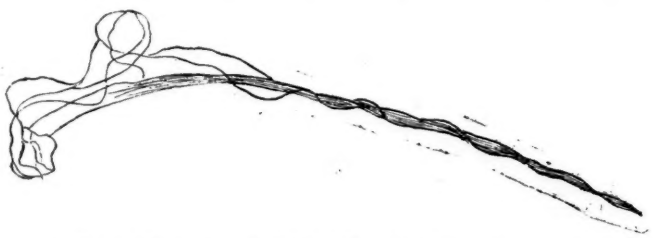


Fig. 3.—Rostrum and bristles of Stomaphis quercus.

More than one species may be in the habit of attacking the same plant. Thus Curtis says, three, if not four assail the turnip. The mischief they do often amounts to an immense sum in pecuniary value, and Buckton cites an authority to the effect that the "fly," as the growers call it, lessened the hop duty in 1802 to the extent of £86,000.

I remarked before that the sweet honeydew secretion does not attract bees who may be feeding close to leaves covered with it. To test this matter still further, I put a bee in a wide tube with a leaf quite sticky with the honeydew, and though the insect was detained for several hours, it never touched this kind of sugar. At this time, however, there are plenty of flowers in bloom. Pettigrew states, in his "Handy Book of Trees," that the bees take it in times of scarcity, and that it spoils the honey. Oaks, sycamores, limes, and beeches often yield a large supply.

Paper-Making in Japan.—Scarcely ten years have elapsed since the first paper-mill was started in Japan, with the latest appliances of American and European machinery, and now there are a dozen mills in operation in that country, several of them earning good dividends

MR. DENNING REJECTS HIS METEORIC DISCOVERY.

By Richard A. Proctor.

MR. DENNING and Col. Tupman (on whose authority chiefly, I had accepted Mr. Denning's observations of unchanging meteor-radiants as proved) agree in asserting that the enormous velocities on which I had based my opinion that some meteor systems were ejected from giant suns with velocities far exceeding those formerly recognised, have no existence. I have no objection to this withdrawal from their position. My ejection theory of meteors remains precisely where it did before Mr. Denning announced these persistent radiants, and before Col. Tupman accepted Mr. Denning's results. But Mr. Denning and Col. Tupman must not expect to remain on both sides of the hedge at once. If Mr. Denning's observations of persistent meteor-radiants are sound the enormous velocities which I have endeavoured to explain (my theory will readily explain them, though it by no means needs them) *must* exist; if these velocities do not exist, Mr. Denning has been deceived and Col. Tupman has been misled.

There is positively no escape from one or other conclusion, without rejecting mathematical principles. The matter is not one of theory at all, but of simple geometrical and kinematical facts.

Here is the reasoning, every point in which is incontrovertible, though it may not necessarily be obvious to persons unacquainted with mathematics:—

1. Meteor tracks in the sky represent the real tracks of bodies passing through our air.

2. A set of meteor-tracks radiating apparently from a point are in reality parallel, unless we suppose such apparent radiation a mere accident (an explanation rejected by Mr. Denning and Col. Tupman).

3. When such a radiant remains unchanged in position among the stars, whether hour by hour or month by month, the meteors reach our air from outside,—unless the star-sphere be conceived to be within the earth's atmosphere (which I believe neither Mr. Denning nor Col. Tupman imagines).

4. Where the radiant of a meteor-system remains unchanged for hours the velocities of the meteors of that system must greatly exceed the velocity with which, owing to the earth's rotation, the observer is being carried around the earth's axis.

5. Where the radiant of a meteor-system remains unchanged for months the velocities of the meteors of that system must greatly exceed the velocity with which, owing to the earth's revolution, the observer is being carried around the sun.

Mr. Denning and Col. Tupman assert confidently that no meteors travel with velocities enormously exceeding the velocity with which the earth travels round the sun.

I assert, with the confidence of absolute certainty, that, *if so*, they are utterly mistaken in supposing that there are meteor-systems really radiating for months from the same point on the star-sphere. The coincidences on which Mr. Denning has based his conclusion, and Col. Tupman his support of that conclusion, must unquestionably have been accidental. The contrary may be asserted, just as the flatness of the earth may be asserted, but it is simply impossible that without velocities enormously exceeding the earth's motion of revolution, meteors can continue to radiate from the same point on the star-sphere while the direction of the earth changes —*as it does in three months*—through one right angle.

If Mr. Denning and Col. Tupman prefer to maintain that certain meteor-systems do radiate for months from the same point, well and good—they are in effect maintaining that certain meteors travel with velocities far greater than those due to parabolic orbits round the sun. If on the other hand they prefer to maintain that no meteors have such enormous velocities, that is also well and good—they are in effect maintaining that no meteor-systems radiate for months from the same point. But it is *not* well and good to maintain both these views at once, any more than it would be to maintain at the same time that a substance is both hot and cold, or both solid and vaporous.

MYSTERIES AND MORALITIES.

By Edward Clodd.

IV.

AS proclaimed in the Banes, the Chester plays were performed at Whitsuntide.

> As in this citie divers yeares the have bene set out,
> Soe at this tyme of Pentecoste, called Whitsontyde,
> Although to all the citie followe labour and coste,
> Yet God guiving leave that tyme shall you, in playe,
> For *three dayes together*, begyninge one Mondaye,
> See these pagentes played to the beste of theire skill;
> Wher to supplye all wantes shalbe noe wantes of good will.

The records of the plays assigned to certain guilds indicate a selection in harmony, as far as possible, with the business of the crafts, as in the performance of the Deluge by the water-carriers of the Dee, and of the Last Supper by the bakers.

Of the particular actors of the Towneley series we know next to nothing, only one or two names of guilds occurring in the manuscript, while of the Coventry our information is derived solely from the guild records, from which the more important excerpts are given in Mr. Sharp's *Dissertation on the Coventry Mysteries*, published in 1825. But the Chester Banes furnish us with a fairly complete guide to the guilds acting the plays in that city, and in the archives of York there is preserved a book dating from the year 1376, temp. Edward III., and containing, under date 1415, a complete list of the plays and the crafts to which they were severally allotted. Comparing a few of the York and Chester together, we have as follows:—

	York.	Chester.
The Creation and Fall of Lucifer	Barkers (*i.e.*, of trees)	Tanners.
Adam and Eve in Eden*	Fullers	Drapers.
Building of the Ark†	Shipwrights	
Noah and the Flood‡	Fyshers and Marynars	Water-leaders, Drawers of Dee.
Abraham's Sacrifice	Parchmyners and Bokebynders	Barkers, Waxe-Chaundlers.
Coming of the Three Kings*	Goldsmyths	Merchant Vintners
Massacre of the Innocents	Gyrdillers and Naylers	Gouldesmythes.
Temptation of Jesus	Smythis	Buchers.
Entry into Jerusalem	Skynners	Corvisors (Shoemakers.
The Last Supper	Baxteres (Bakers)	Bakers.
Crucifixion†	Pynners and Paynters	Fflechers, Bowyers, Coopers,§ Stringers, and Ironmongers.
Harrowing of Hell‡	Sadilleres	Cooker.
Resurrection‡	Carpenters‖	Skynners.
Travellers to Emmaus	Sledmen (Porters)	Saddlers.
The Judgement	Merceres	Weavers.

* In Dublin by the Glovers.
† In Newcastle-on-Tyne by the Shipwrights.
‡ In Dublin by the Mariners and Vintners.

The Coventry series, like the Chester, is preceded by a proclamation giving metrical lists of the several plays.¶ The Chester "vexillator," or herald, prefaces his "banes" with several stanzas before reciting the subjects and bidding the players take their places, but the Coventry prologue, which was delivered by three heralds, starts with the briefest announcement to

> Gentyllys and Zemanry of goodly lyff lad,
> This tyde,
> We xal you shewe, as that we kan,
> How that this werd ffyrst began,
> And how God made bothe molde (earth) and man,
> Iff that ze wyl abyde.

Space permits the quotation of only a few verses from the two prologues for purposes of comparison, showing the fuller and more poetical form of the Coventry, which is also the most elevated in tone and dignity of the four collections.

Chester Banes.

> Nowe, you worshippfull tanners, that of custome olde
> The fall of Lucifer did sett out,
> Some writers awarrante your matter, theirfore be boulde,
> Erstelye to playe the same to all the rowtte;
> And yf any thereof stande in any doubte,
> Your authour his authour hath, your shewe let bee
> Good speech, fyne players, with apparrill comelye.

Coventry Banes.

> In the ffyrst pagent, we thenke to play
> How God dede make, thorowe his owyn myth,
> Hevyn so clere upon the fyrst day,
> And therin he sett angelle fful bryth.
> Than angelle with songe, this is no nay,
> Xal worchep God, as it is ryth;
> But Lucyfer, that angelle so gay,
> In suche pompe than is he pyth,
> And set in so grete pride,
> That Goddys sete he gynnyth to take,
> Hese lordys pere hymself to make,
> But than he ffallyth a ffend ful blake,
> Ffrom hevyn in helle to a [bide].

Chester Banes.

> The appearinge angell and starr upon Christes beirth
> To sheapheards poore, of base and lowe degree,
> You painters and glasiors decke out with all meirth,
> And see that *Gloria in excelsis* be songe merelye.
> Fewe wordes in that pageante makes meirth truely,
> For all that the altar had to stande uppon,
> Was glorye to God above, and peace one earth to man.

* In Coventry by the Shearmen and Taylers.
† In Coventry by the Smiths.
‡ In Coventry by the Cappers.
§ Trades connected with archery; the fflechers fixed the feathers on the arrows.
‖ In Dublin the House Carpenters performed "The Buriall of Christ."
¶ No prologue has survived with either the York or Towneley series.

Coventry Banes.

In the xvj pagent Cryst xal be born,
Of that joy aungelys xul synge,
And telle the shepherdys in that morn
The blysseful byrth of that Kyng.
The shepherdys xal come hym befforn,
With reverens and with worchepyng,
Ffor he xal savyn that was forlorn,
And graunt us lyff evyn more lestyng,
I wys,
This gle in grythe
Is mater of myrthe,
Now Crystys byrthe,
Bryng us to his blys!

Chester Banes.

And nexte to this, you, bowchers of this citie,
The storie of Sathan, that Christe woulde needes temp'e,
Set out as accostamablie have yee
The devill in his fethers all ragger and rente.

Coventry Banes.

In the xxth pagent alle the develys of helle,
They gadere a parlement, as ye xal se,
They have grete doute the trewth to telle,
Of Cryst Jhesu whath he xulde be.
They sende Sathan, that ffynde so ffelle,
Cryst for to tempte in fele degré:
We xal yow shewe, if ye wyl dwelle,
How Cryst was temptyd in synnys thre
Of the deyvl Sathane;
And how Cryst answeryd onto alle,
And made the ffende awey to falle,
As we best may this shewe we xalle,
Thorwe grace of God and man.

Chester Banes.

You, ffletchers, boweyers, cowpers, stringers, iremongers,
See soberly ye make of Christes dolefull death,
His scourginge, his whippinge, his bloude shedde, and
And all the paines he suffered till the last passion of his breath:
Lordinges, in this storye consisteth our cheeffe ffayth.

Coventry Banes.

In the xxx pagent thei bete out Crystes blood,
And nayle hym al nakyd upon a rode tre,
Betwen ij thevys, i-wys they were to wood (very mad)
They hyng Cryst Jhesu, gret shame it is to se.
Vij wurdys Cryst spekyth hangyng upon the rode,
The weche ye xal here alle tho that wyl ther be,
Than doth he dye ffor oure allether* good;
His modyr doth se that syth, gret mornyng makyth she,
Ffor sorwe she gynnyth to swowne.
Seynt John evyn ther as I yow plythe,
Doth chere oure lady with al his mythe,
And to the temple anon forth rythe,
He ledyth here in that stownde (time).

Chester Banes.

As our beleeffe is that Christe, after his passion,
Descended into hell, but what he did in that place,
Though our authour sett fourth after his opinion,
Yet creditt you the best learned, those doth he not disgrace:
We wishe that of all sortes the beste you ymbrace;
You, cookes, with your carriage see that you doe well
In pagente sett out the harrowinge of hell.

Coventry Banes.

In the xxxiiij pagent xal Maryes thre
Seke Cryst Jhesu in his grave so coolde;
An aungel hem tellyth that aresyn is he;
And whan that this tale to them is tolde,
To Crystes dyscyplis with wurdys fful fre,
They telle these tydynges with brest ful bolde.
Than Petyr and John, as ye xal se,
Down rennyn in hast over lond and wolde,
The trewth of this to have.
Whan thei ther comyn, as I yow say,
He is gon ffrom undyr clay,
Than ther wytnesse anoon that day,
He lyth not in his grave.

* Genitive plural of *all*.

The last verse of the Chester Banes, after citing the words of Jesus to the righteous at Doomsday, closes with lines touching in their simplicity, and in the prayer for the salvation of the spectators which they utter:—

To which rest of wayes and selestiall habitation
Grante us free passage, that all together wee,
Accompanied with angells and endlesse delectation,
Maye contynually laude God and prayse that King of Glorye.

The Coventry prologue ends with a prayer and business announcement in combination, reminding us of the notices from modern pulpits accompanying the benediction:—

Now have we told yow alle be-dene (obediently)
The hool mater that we thynke to play;
Whan that ye come, ther xal ye sene
This game wel pleyd in good aray.
Of holy wrytte this game xal bene,
And of no fablys be no way,
Now God them save from trey and tene (trouble and harm)
Ffor us that prayth upon that day,
And gwyte them wel ther mede.
A Sunday next, yf that we may,
At vj of the belle we gynne oure play,
In N. towne, wherfore we pray,
That God now be youre spede.
Amen.

In all the pageants of the *Creation* the exceedingly popular legend of the fall of Lucifer from heaven* was introduced. God appears, declaring himself

Alpha et o
The first and last also:
One God in trinyte,†

and receives the adoration of the angels, who sing "Holy, holy, holy, Lord God of Sabaoth" before him. That the plays were accompanied by music is evident from the stage directions, and from the pieces collected both by Mr. Sharp and Miss Toulmin Smith, as also from the entries in the records of the Coventry guilds extracted by the former. *E.g.*—

1451. Itm. payd to the mynstrells viii s.
1471. Itm. spend on mynstrells dinr and thr sop on Corps x^{t} day xx^{d}.
1477. It.^{m} payd to the wayts for pypyng v s.
Itm. payde to hym that playde on the flute ii s, vi d.

But the specimens have neither much melody nor value, and can only be imperfectly translated from the old notation into modern signs of semibreves, minims, and the like. After the angels' song, God descends from his seat and goes out, whereupon Lucifer usurps his throne and demands the worship of the angels.‡ The loyal and rebellious disagree, and the dispute is ended by the return of the Deity, who casts the arch-traitor and his followers from heaven.

Deus. Thus Lucyfere ffor the mekyl pryde,
I bydde the ffalle from hefne to helle;
And alle tho that holdyn on thi syde,
In my blysse nevyr more to dwelle.
* * * * *

Lucyfer. At thy byddyng thi wyl I werke,
And pas fro joy to peyne smerte,
Now I am a devyl ful derke
That was an aungelle bryht.§

* Partly based on Isaiah xiv. 13, 14; Revelations xii. 7–9; and the words of Jesus, "I saw Satan like lightning fall from heaven," Luke x. 18. In his fall to the abyss of hell he broke his leg like Hephaistos when hurled from heaven by Zeus, and hence in Aryan myths the legend of the lame devil (*diable boiteux*).

† In the Chester variant the Deity asserts his power and glory in alliterative rhyme, and calls himself "Prince principall proved in my perpetuall provydence."

‡ Hic Deus recedit a suo solio et Lucifer sedebit in eodem solio. —*Towneley Mysteries.* "Creatio," p. 3.

§ *Coventry Mysteries*, p. 21.

The arrangement of the *Creation* differs somewhat in each of the series: in the York, where it fills a cycle of six plays, God has made the earth before Lucifer's expulsion, and since it grew dark when "the fendes fell," he divides the darkness from the light, and then creates the host of heaven and all living things, from "erbys and also othyr thyng" to "man like vn-to me." In the Towneley, the fall of Lucifer is interposed between the creation of all things and of Adam and Eve, who are led by the Cherubym to Eden and forbidden to touch the "tre of life." In the Coventry variant, the creation of everything, save the heaven where God and his angels dwell, follows the expulsion, and to Adam and Eve are given "paradys" with "flesche and ffysche and frute buxum (obedient) at their byddyng."

> Here is pepry, pyan, and swete lycorys,
> Take hem alle at thi lykyng,
> Both appel and pere and gentyl rys (boughs)
> But towche nowthe this tre that is of cunnyng.

There can be little doubt from the evidence of the stage directions, and the references of opponents of the plays, that Adam and Eve appeared upon the stage naked. In the Chester series it is stated that they *stabunt nudi, et non verecundabuntur*, and another marginal direction, when their fall is performed, is that they shall cover *genitalia sua cum foliis*.*

INFLUENCE OF MECHANICAL INVENTION.

IN a recent issue of *Bradstreet's* the subject of "Progress in Manufacturing" is touched upon, and it is shown by reference to researches of Mr. Edward Atkinson to what extent the world is indebted to mechanical invention for the great abundance of useful commodities. The result is shown in a clear manner by the aid of charts. For the purpose of illustrating his argument or theory, Mr. Atkinson selected, among other industries, the manufacture of cotton sheetings, comparing the prices and other figures of 1840 with those of 1883 and 1885. The data were obtained from two mills which have always been successful.

In 1840 the product of cotton sheetings per hand per year was 9,600 yards, while in 1883 it was 28,032 yards, an absolute increase of 190 per cent. in efficiency of labour growing out of improvements in machinery.

In 1840 the number of spindles was 12,500; in 1883 it has increased to 30,800, an increase of 146 per cent.

The value of product per head in 1840 was 868 dols.; in 1883 it was 1,973 dols., an increase of 127 per cent.

The rate of wages per hour in 1840 was 4·49 cents. In 1883 it was 8·80 cents, an increase of 96 per cent.

The rate of wages per year was 175 dols. in 1840, and in 1883, 287 dols., an increase of 64 per cent.

The number of operatives in 1840 was 530, in 1883, 527; remaining about the same, while the increase in machinery was about 186 per cent.

The hours of labour were thirteen in 1840, and eleven in 1883, being a reduction of about 15 per cent. In 1840 the price of cloth was about 9 cents, while in 1883 it had been reduced to about 7 cents, being a reduction of about 22 per cent.

Estimating the proportion of price to profit on fixed investment at 10 per cent., the profits in 1840 were 1·18 cents, in 1883 0·43 cent, being a decrease of 80 per cent. in the proportion of the product assigned to profit.

Mr. Atkinson has summarised the progress as follows:—

"Fifty years ago the average earnings of all the operatives in a large cotton-mill, who were worked thirteen hours or more a day, and among whom were comprised a much larger proportion of men than at the present time, while the women were older and there were fewer children, were 2·50 dols. and 2 62 dols. per week. The quantity of machinery which each hand could tend was much less; the production of each spindle and loom was less; the cost in money of the mills per spindle or loom was much greater, while the price of cloth was at times more than double the price at which it can now be sold with a reasonable profit. The average earnings of all the female operatives in what purports to be the same factory, at the present time, on the same fabric, working ten or eleven hours a day, are 5 dols. per week, and in some cases even 6 dols. or more to the most skilful. That is to say, women now earn about twice as much in ten hours as men and women combined averaged in thirteen hours then. The course of events has been as follows:—A continuous reduction in the hours of labour, coupled with an increase in the earnings per hour; a diminution in the ratio of capital to production, coupled with an increase in its productive efficiency; a constant increase in the supply of cotton fabrics *per capita*, coupled with a decrease in the price; a continuous increase in the purchasing of gold dollars in respect to almost all articles of necessary subsistence."

It is pointed out that these facts afford a complete demonstration of the fallacy that high wages and high cost of production are synonymous; that the rate of wages is only one of many elements instead of the single important element in determining the cost of production in any industry; that it is quite possible that the highly-paid labour in our best cotton-mills costs less per pound or yard of product than the "pauper labour" in English mills, and that if the obstacle of obstructive tariff taxes on sundry things which they have to use were cleared away, American manufacturers would be more than able to hold their own.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

THE ROCKS OF THE LICKEY.

(*Continued from page* 71.)

TWELVE miles south-west of Birmingham there rises the little rocky ridge called the "Lower Lickey," which it is the object of this paper to describe. The Midland line from Birmingham (New-street) to Worcester and Gloucester touches the south-east end of the Lickey at the small station called Barnt Green; or we can reach the north-western extremity of the ridge by the Great Western line (Birmingham, Snow-hill station), which will take us *viâ* Old Hill and Halesowen to Rubery. A good plan is to go by Great Western to Rubery, examine the country, and return from Barnt Green by the Midland line.

Getting out at Rubery [see Map (1)], the visitor finds himself in front of a grand section exposed by the railway-cutting, which shows the typical rock forming the

* Some slight covering must, however, have been worn by the impersonators of women's characters, as female performers did not appear on the English stage till 1629. Under date of Jan. 3, 1661, Pepys records: "To the theatre, where was acted 'Beggars Bush,' it being very well done; and here the first time that ever I saw women come upon the stage."

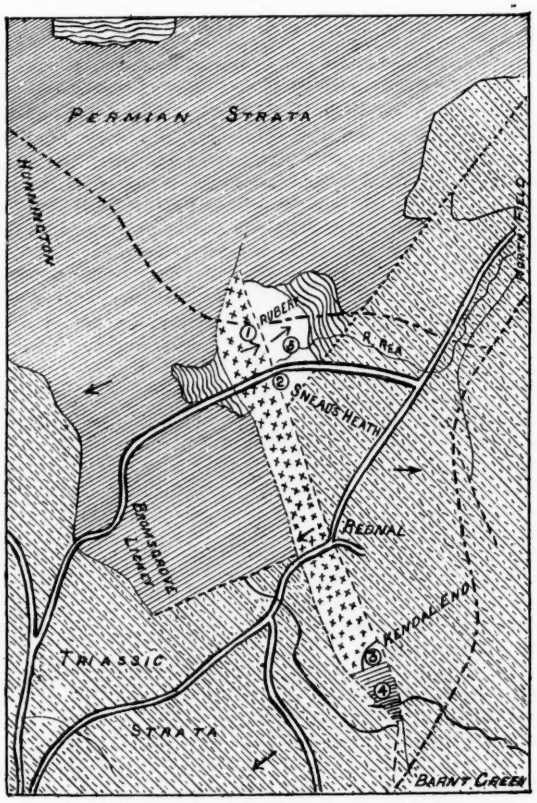
little line of hills he is about to examine. Here the strata have a slant or "dip" to the south-east of about thirty-five degrees, and they rise vertically in the cutting to a height of forty feet. The rock is a quartzite—a very old, altered sandstone. Under the microscope, the original grains of sand are still discernible in thin slices of the rock, but they are compacted together by an interstitial deposit of silica, left behind—ages ago—by heated water, which then soaked through the stone. Here and there specks of whitish decomposed felspar are visible in hand specimens. The tint of the stone is a greyish or pinkish white, but in some of the quarries at the southern end of the ridge a darker, redder tinge prevails. The rock is very much jointed, so that it is impossible to get a sound lump of stone of any size. For this reason it cannot be worked into square "setts" for paving, but is simply broken into small rubble, which is used for mending the local roads. No trace of any fossil has ever been found in the quartzite proper, and lithologically it is indistinguishable from the quartzite of Nuneaton, which we lately described (p. 71), and from that of the Wrekin, of which we hope to speak in another article.

Geology owes much to railways. The cutting at Rubery shows a capital section of a "fault," by which the rock has been raised on one side of a crack or fissure some eight or ten feet above the corresponding bed on the other side. The "fault" here is clear as a diagram; but of the many such hidden dislocations by which this region is traversed, several of which have displaced the strata, not tens, but hundreds, or it may be thousands of feet, we can generally only infer the existence, actual sections crossing and exposing the line of fault being, as a rule, wanting.

Walking now to the south-east, over the first hummocky elevation which lies before us—Rubery Hill—we note other quarries on the road-side in which the strata lie nearly horizontally, and at last they curve over and dip to the west, showing that the structure of the Lickey ridge is that of a broken anticlinal or saddle. A few minutes' walk brings us to a valley crossing the ridge, and coinciding with a line of fault. Lines of fault are very frequently lines of weakness, for the rock on either side of the actual line of dislocation is almost certain to be more or less broken, fissured, and thereby weakened. The agents of denudation—the rain, rivers, frost, and ice—take advantage of this breaking-up, and erode the rocks along the fault-line, so that it is converted into a valley or ravine, whose bottom may be traversed by a stream, or filled up with débris and covered with vegetation. This is one reason why clear sections, showing the actual course of a fault, are not of more common occurrence.

Coming into the main road, which takes advantage of the break in the ridge, we see another quartzite quarry in front, while the gates of the large new Lunatic Asylum are close at hand on the left. The roadside wall opposite the Asylum gates is composed of a reddish friable sandstone, quite different from the hard quartzite of the hills, and a little search is sufficient to discover on the rocky slope beyond the wall the junction of the two rocks. [See Map (2).] The quartzite is clearly the older of the two, for the sandstone rests upon it and fills up hollows and pockets as if it had been deposited on a sloping shore; moreover, it contains at its base well-rolled lumps of the metamorphic rock as large as one's fist.

A little search reveals the fact that the sandstone is crowded with fossils, which are chiefly casts of a brachiopod shell called *Stricklandinia lirata*, together with a *Pentamerus*, and a little coral, *Petraia bina*. These fossils enable us to refer the sandstone to the Upper Llandovery Beds (or *May Hill sandstone* of Sedgwick) which are elsewhere known to form the base of the Upper Silurian Formation. But the quartzite is of early Cambrian, or even possibly of pre-Cambrian age, so that there is a time-break between the two strata of enormous magnitude. The quartzite was deposited as a sandstone, metamorphosed into a quartzite, and elevated to form a sloping, uneven sea-bottom or shore before the Llandovery sandstone was deposited upon it. The dip of each set of rocks is now to the eastward, but the angle of dip of the quartzite is much greater than that of the sandstone.



Geological Map of the Lower Lickey Hills.—Quartzite. Coal Measures. Permian. Trias. Silurian. Pre-cambrian. Prevailing dip shown by arrows ↘.

Crossing the road at this spot, which rejoices—or rejoiced—in the name of Snead's Heath, we enter the Asylum grounds [see Map (5)], and turn sharply to the right through a small plantation, across which a little brook—one of the sources of the Rea—has cut a channel, with vertical sides some ten feet deep. Along this brook-course are exposed the Silurian shales and limestones which rest upon the Llandovery sandstone. The thin limestone bands here contain numerous and well-preserved fossils, which prove them to be the equivalent of the Woolhope or Barr limestone. Searching still further to the east, the coal-measure shales which cover the Silurians are found, and beyond and upon all come Permian

and Triassic strata, which encircle the little rocky eminences of the Lickey like the waves round a lonely ocean isle.

(To be continued.)

THE RUDDY ECLIPSE OF THE MOON.

By Richard A. Proctor.

THAT Mr. Williams would "still fail to understand how the sun can be *all* refracted and *all* brought above the earth's horizon and *all* thus seen from the moon," yet the moon be in shadow as compared with her state when the earth is not in the way, seemed, I fear I must say, but too probable to me, even as I wrote what I intended to be a clear and satisfactory explanation of the facts. I perhaps scarcely expected that he would put his renewed failure to understand the matter as a new basis for his entirely erroneous ideas on the subject. But that is his affair, not mine.

I simply repeat or state that,

1. The whole of the sun is demonstrably visible from the moon at the time of central eclipse, when the bounding horizon of the earth is clear of clouds.

2. The apparent area of the distorted image of the sun thus seen is less than one-880th of the area of the apparent disc of the sun when not eclipsed.

3. Apart from absorption the image cannot have an intrinsic brightness greater than that of the sun himself.

4. Absorption acts effectively to reduce the lustre of the distorted image of the sun seen from the moon.

5. Usually, too, a portion of the earth's bounding horizon is clouded. Therefore

6. The total amount of light falling on the moon during central eclipse is much less than that falling on the moon at other times.

7. This is the accepted explanation, as normally understood.

If Mr. Williams will be at the pains to look at the sun through a telescope or powerful opera-glass, the wrong way,—that is, through the larger end—he will find that *all* the sun is thus seen, yet without radiating to his eye *all* the normal amount of luminous or calorific energy *minus* of course that absorbed by the glasses. Again if on a bright and sunny day he will be at the pains to set up a telescope, or to hold a powerful opera-glass towards the sun, with the small end nearest to that luminary, but the optical axis carefully directed towards the sun, and then place a piece of white paper or card so as to receive those rays from the *whole* sun which the former experiment shows to be shining down the telescopic tube or through the opera-glass, he will find that the part of the card so illuminated is very manifestly in shadow as compared with the part outside. The shadow is not black, but it is very dark, and the greater the power of the telescope the darker is the shadow, corresponding to the circumstance that the greater the power of a telescope through which we look the wrong way at the sun the farther away—that is, the smaller—he looks. Yet once more, if Mr. Williams will look at the sun or moon or any luminous object through a telescope with one eye, while with the other he looks directly at that object, he will find that whether he looks through the right end or the wrong end (he could only look at the sun through the right end when the sun's light is much dimmed by fog or haze) the image seen through the instrument *never* looks brighter than the object seen directly. It may give more light, looking larger or nearer, but it never looks more brilliant intrinsically. Consequently, if it looks very much smaller, very much less light is received from it.

This again is an accepted law,—because it happens to be a demonstrated fact. The explanation is that which I have given in my essay on the Laws of Brightness.

The law is true whether the image seen is distorted or not.

A similar law applies in the case of reflexion. The total solar radiation (less loss at reflexion) is in a sense received from the minute image of the sun seen in a convex mirror; but it is received in such a way as to spread more widely, and consequently the total amount received by the eye pupil, or by any given surface exposed to this radiation, is very much less than that received directly from the sun.

The rays of the sun which fall on the zone of our air above the earth's horizon, as seen from the moon, are deflected in such varying degrees according to the height of the layer through which they pass, that they are in a sense diffused, so as to be spread—like water from a rose—over a very much larger region than they would otherwise illuminate. They illuminate, therefore, the region on which they fall very much less strongly,—or in other words that region is in dark (though not black) shadow.

The focus of a pencil of sunlight coming through the earth's atmosphere in such a direction as to fall, after deflection, on the moon's surface, lies—not where Mr. Williams has imagined, between the earth and moon, but—many many millions, nay many hundreds of millions of miles beyond the sun. Thus if an eye were at the moon's surface to receive a part of that pencil after refraction through the earth's atmosphere, it would get but a very small allowance of light from it. So with other pencils from other parts of the sun's surface. The moon's surface then would assuredly (by which I mean demonstrably and calculably) be in dark though not absolutely black shadow, even if the earth's atmosphere were perfectly clear.

Mr. Williams' version of the accepted explanation is *not* as he imagines "that given by Sir John Herschel," who assuredly does not "ascribe the ruddy hue of the moon to the *twilight* glow of our atmosphere." Sir John Herschel says on the contrary that the lowermost strata of our atmosphere "impart to all the rays they *transmit* the ruddy hue of *sunset*, only of double the depth of tint which we admire in our glowing sunsets, by reason of the rays having to traverse twice as great a thickness of atmosphere." The *twilight glow* and the *glow of sunset* are two entirely different things. The sun owes his ruddy glow when setting to the rays which our atmosphere transmits; the glow of twilight is due to rays which are not transmitted, but reflected and dispersed. The lower strata of the atmosphere in their normal state (I mean as to matter suspended in them or diffused through them) transmit red, orange, and yellow rays more freely than green, blue, indigo, and violet rays. Hence the setting sun usually looks ruddy—(this beyond question is what Herschel refers to when he speaks of the ruddy hues of sunset). When these red rays of the sun fall on clouds, or rocks, or icebergs, or any substance capable of reflecting or dispersing them they make that substance look red. This ruddy reflected or dispersed light is what we see in twilight. But if Herschel had regarded this twilight glow as the cause of the ruddiness of the eclipsed moon, he would not have spoken of double the depth of tint by reason of twice the depth of atmosphere being traversed; for the more of this twilight colour in our air

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the less tint could get through to the moon, and Herschel distinctly speaks of the tint as transmitted. When recently the twilight glows were particularly ruddy the sun himself looked greenish.

It should not be necessary, I need hardly say, for me to defend Sir John Herschel's explanation against Mr. M. Williams's interpretation, which in reality reduces it to something scarcely distinguishable from absurdity. What Herschel really says, is,—that our atmosphere, which through its normal absorptive power makes the sun look red when setting, must make him—that is, his distorted image—look doubly red as (supposed to be) seen from the moon; for while *we* see the setting sun through a certain range of our atmosphere, the imagined lunarian would see the sun (much reduced in apparent size and strangely distorted in shape) through double that range.

Mr. Williams must really not ask any one who understands the accepted and demonstrable interpretation of the ruddy eclipsed moon, to permit the existence (as a live creature) of that straw giant which he first set up as "the accepted theory expressed by Sir John Herschel" and then triumphantly proceeded to slaughter in the *Gentleman's Magazine*.

That was all I cared to state (to Mr. Williams), and to explain for any who might not happen to have understood clearly what the accepted explanation is, but at the same time possessed sufficient knowledge of optics and physics, and sufficient patience, to follow and grasp the considerations actually involved in the matter.

The self-glowing tufaceous matter may be left to itself. I know no reasons for supposing that the moon's surface is tufaceous, but many for supposing otherwise; I can see no reason for supposing that "a tufaceous lunar surface if it existed would become self-luminous under solar radiation," but on the contrary I find evidence, in the thermometric observations on the last total lunar eclipse visible in England, apparently demonstrating the reverse. But I do not think the theory wants killing.

As for Mr. Williams's figures, I can only say that all experiments yet made in the way of measuring the moon's radiation of heat are entirely inconsistent with them. So much the worse, he may think, for the experiments. I take a different view.

I object to Mr. Williams's statement that I and others *accepted* his views about Jupiter, Saturn, Uranus, and Neptune. I published the views which I at present hold about Jupiter and Saturn, and the evidence—chiefly observational—on which I based them, in lectures delivered before the Royal Institution at Manchester (the syllabus of each lecture is preserved in the records of that institution), several months before the "Fuel of the Sun" was published. It was in that work that Mr. Williams published his views. How long he had entertained them, or perhaps talked about them, before, I do not know. But I know that I had never heard of his holding them, till long after I had publicly discussed them.

I do not say this as caring two straws about priority in the matter. I have always pointed out that Buffon came long before any of us in the idea that Jupiter and Saturn are fiery-hot planets. And very likely others preceded him. Sir Isaac Newton certainly showed long before Buffon that larger masses are longer than smaller ones in cooling. But while only children and simpletons are concerned about priority in such matters, I emphatically object to being described as accepting Mr. Williams's views, in presence of the fact that I have never referred to him as having in the slightest way or degree suggested the views I hold. If I *had* borrowed from him, my whole conduct in the matter would have been excessively mean, and therefore exceedingly foolish. I object to being presented as either one or the other.

Let me remark, in conclusion, that Mr. Williams twists a remark of mine quite out of its real meaning when he represents me as saying that "19-20ths of his 'Fuel of the Sun' is out of the pale of science." Every one would understand that to mean that I considered nearly the whole of his book as unscientific, as inconsistent with known scientific facts. My actual words were very different, and could not be understood in that sense,—I said "I doubt even if 19-20ths of my friend's 'Fuel of the Sun' must not be regarded as outside the fairly-defined limits of the field of knowledge." I am satisfied that no one understood me to mean more than that some such portion of Mr. Williams's theories must be regarded as not representing known truths. His hypotheses are for the most part not proven; but this is not saying that they may not be proved; and still less is it saying that they are contrary to knowledge.

Mr. Williams may rest assured that if one-twentieth of the new ideas in his book shall come to be regarded as established truths, the work is well worth the praise which—he tells us—Sir Charles Lyell gave to it. Considering that many of even Newton's ideas about physical matters have not only not been established or confirmed, but have been definitely disproved, Mr. Williams could hardly hope to be right all through or even in the greater part of his work; still less could he expect his hypotheses to be *already* regarded as established truths,—that is, within the fairly-defined limits of the known.

Mr. Williams might have added that "the idea prophetically suggested by Sir Isaac Newton" was widely known at the time when it was started, and (unlike Newton's theory of gravitation) was somewhat profusely ridiculed.

TRICYCLES IN 1885.

By John Browning.

(*Chairman of the London Tricycle Club.*)

UNSAFE TYRES.

SOME years ago a distinguished man of science committed suicide. No light could be thrown on the cause for his doing so. Speaking to a well-known physician on the subject he said the suicide was caused by suppression, "the man had never given vent to his feelings." Now as I do not wish to die of suppression, I propose to express my feelings freely on the subject of unsafe tyres.

Rubber tyres ought clearly to be made to stick firmly on to our wheels, but they are now generally made to come easily off. Considering that a tyre is most likely to come off when the machine is running down a steep rough hill, it is wonderful to me that we have not had more accidents from this source than have happened.

Riding one day along the Brighton road, I saw a strange object coming towards me, which looked like a small cart with the wheels uppermost. On coming closer I found that it was a gigantic labourer holding a tricycle, with 50 in. wheels, at arms'-length above his head, and in this manner carrying it along the middle of the road. "That's a bad job," said I, as he was passing by. "Not for me," said the giant, grinning from ear to ear; "it will get me and my kids a dinner to-morrow." "Where's the rider?" said I. "They've put him in the train at

the Junction," said he, "and I am carrying this to Krydun (Croydon) to be set to rights."

Then he explained in his own way that one of the tyres had come off when running down a hill, and, catching in the chain, had suddenly stopped the machine, making it turn several somersaults. The rider was badly injured, and the machine was so bent, torn, and damaged that it could not be wheeled, and I would never have trusted it again had I been the owner, no matter who might have repaired it.

Since hollow rims have come into use tyres have come off more frequently than before. This arises from the fact that the rims are shallower than the solid rims were, that the cement runs away through the holes made to receive the heads of the spokes, and that it is difficult to make the rim hot enough to melt the cement without unsoldering the rim.

The most frequent cause of loose tyres is, however, that the makers finish and paint, or enamel the machines before they put on the tyres, and they are afraid afterwards to make the rims hot enough to melt the cement for fear of blistering or damaging the appearance of the paint or enamel. The rims are mostly only just warmed sufficiently to make the tyres adhere, and a few miles run over a rough road will soon loosen them or bring them off.

To ensure the perfect adhesion of tyres, the surface of the tyres should be cleaned with turpentine, or, better still, seared with a hot iron; the rims should be well coated with a good tough cement (Loudon's is the best I have tried), and should then be heated until the cement runs out of each side of the rim, and the tyre should be well knocked down with the palm of the hand while the cement is hot. If the utmost security is desired the tyre should be bound round, not too tightly, with a broad tape, which should not be taken off for several hours.

When the tape is removed the superfluous cement should be cut or scraped away, and then, and not before, the wheel should be painted or enamelled.

Tyres put on as I have described should—if the cement used has been good—adhere firmly until they are worn out.

The truth is, that the method of fixing our tyres on simply by means of cement is a miserable makeshift, with which we ought not to rest satisfied. It necessitates the tyre being smaller in diameter than the rim, so that it shall be stretched on. The result is, that every slight cut opens more and more, until it becomes a gash, which almost divides the tyre. By rights, the tyre should be compressed into the rim, then a cut would go no further. Timberlake threaded the tyre upon a stout wire and compressed the tyre into the rim. As I have seen tyres made on this plan, which I was assured had run over 10,000 miles without coming off, and which were then nothing like worn out, I cannot think why this plan has not been more generally adopted.

A few months since, Warwick, of hollow rim fame, advertised a special rim and tyre, in which the top edges of the rim were turned over on each side inwards, and these edges fitted into grooves in the sides of the tyre. Once in the rim these tyres, I am told, could not be dislodged unless proper tools were used for taking them out, but I have not been able to see any of them in use. Why not?

British and American Steel.—In 1883 Great Britain produced 76,035 more tons of Bessemer steel than the United States. In 1884 matters were reversed, the United States producing 74,531 tons more than Great Britain.

ODD SUPERSTITIONS.

STRANGE NOTIONS OF PEOPLE IN VARIOUS COUNTRIES CONCERNING MATRIMONY.

THERE is, perhaps, no period in a woman's life that so completely changes her whole existence as marriage, and for that very reason she is apt to be more superstitious and fanciful at that time than at any other; and while superstitions are fast becoming a something of the past, there are very few women who will not hesitate before making Friday their wedding-day, or will not rejoice at the sunshine, for "happy is the bride the sun shines on." June and October have always been held as the most propitious months in the twelve—a happy result being rendered doubly certain if the ceremony was timed so as to take place at the full moon, or when the sun and moon were in conjunction.

The Romans were very superstitious about marrying in May or February; they avoided all celebration days, and the calends, nones, and ides of every month. The day of the week on which the 14th of May fell was considered very unlucky in many parts of "merry old England," and in the Orkney Islands a bride selects her wedding-day so that its evening may have a growing moon and a flowing tide. In Scotland the last day of the year is thought to be lucky, and if the moon should happen to be full at any time when a wedding takes place the bride's cup of happiness is expected to be always full. In Perthshire the couple who have had their banns published at the end of one and are married at the beginning of another quarter of a year can expect nothing but ends.

The day of the week is also of great importance, Sunday being a great favourite in some parts of England and Ireland. And although an English lass would not marry on Friday, the French girl thinks the last Friday in the month particularly fortunate. Most of us know the old saying concerning the wedding-day:—

Monday for wealth,
Tuesday for health,
Wednesday the best day of all;
Thursday for crosses,
Friday for losses,
Saturday no luck at all.

In Yorkshire, when the bride is on the point of crossing her father's threshold, after returning from church, a plate, containing a few small pieces of cake, is thrown from an upper window of the house by a male relative. If the plate is broken, she will be happy; if not, she will not expect to escape misery.

In Sweden a bride must carry bread in her pocket, and as many pieces as she can throw away just so much trouble does she cast from her; but it is no luck to gather the pieces. Should the bride lose her slipper, then she will lose all troubles, only in this case the person who picks it up will gain riches. The Manxmen put salt in their pockets and the Italians "blessed" charms.

It is an unhappy omen for the wedding to be put off when the day has been fixed, and it is believed much harm will ensue if a bridegroom stands at the junction of cross roads or beside a closed gate on his wedding morn. In England it is thought to be a bad sign if a bride fails to shed tears on the happy day, or if she indulges herself by taking a last look at the looking-glass after her toilet is completed; but she may gratify her vanity without danger if she leaves one hand ungloved. To look back or go back before entering the church-door, to marry in green, or while there is an open grave in the churchyard, are all unfortunate, and the bride must be

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careful to go in at one door and out at the other. When the bridesmaids undress the bride they must throw away all the pins. Woe to the bride if a single one be left about her—nothing will go right. Woe to the bridesmaids if they keep one of them, for they will not be married before Whitsuntide, or until the Easter following at the soonest.

If the bridal party venture off dry land, they must go up stream. The bride must, to be lucky, wear

Something old and something new,
Something gold and something blue.

If she should see a strange cat or hear a cat sneeze on her wedding-day, then she will be very happy; and if on her wedding morning she steps from her bed on to something higher, and again on to something higher still, she will from that moment rise in the world.

Gossip.

I am sorry to have occasion to touch once more—it shall be for the last time—on the relations between George Eliot and Mr. Lewes. "Gamma" considers that the relationship, "too severely censured by 'Commentator' has been too much defended" by me. I plead guilty to the reverence and love for George Eliot which "Gamma" regards as the cause of my undue defence. But I venture to think that he, though in less degree than "Commentator," is mistaken as to the nature of the relationship he reprehends. From his remarks, one would imagine that George Eliot and Mr. Lewes were somewhat young persons who fell hopelessly in love with each other, and, thus tempted, disobeyed the laws, moral and social, regulating the relations between the sexes. "Gamma" implies also that it was George Eliot, author of "Adam Bede," and therefore one who had set herself up as a teacher, who thus offended. The facts of the case are different. George Eliot was a middle-aged lady, in delicate health, and of narrow means, not as yet the author of any work which had attracted attention, when she made the acquaintance of Mr. Lewes, then well advanced in middle life and a valetudinarian. I need not touch on the unhappy circumstances of Mr. Lewes's married life at that time. Suffice it that his wife, who had gone off with a man of wretched nature, managed so that a legal quibble prevented him from obtaining a divorce in this country, to which he was morally entitled. It was during this season of affliction that George Eliot's sympathies were excited by the unhappy condition of Mr. Lewes's children. On his side there had long been great interest in her literary and philosophical work; and he had recognised the necessity which existed for guidance and sympathy, even though her powers were higher in most respects than his own. That under these circumstances they should decide to seek under the laws of another land the union which a quibble of our divorce laws forbade here, may be regarded, if men will, as injudicious, regrettable, unfortunate, and so forth; but certainly not as guilty or immoral. The passions had nothing to do with the decision; the interests of others besides George Eliot and Mr. Lewes were thoughtfully considered. And so far as the world is concerned, all the best of George Eliot's writings and a large part of the best of Mr. Lewes's later work, would probably have had no existence had their decision been different. This may seem to some a small matter: weighed indeed against a strictly moral obligation it might well be thought so; but George Eliot and Mr. Lewes offended, if at all, against a legal not against a moral obligation,—nay, against only a legal quibble.

I have diligently cancelled every letter or part of a letter bearing on the private life of George Eliot, including some already in type, and several which expressed very just and kindly views. I wish what I have said myself to be regarded simply as expressing my regret that matters with which none of us have the least concern should have been permitted—accidentally, I am well assured—to appear in these columns. Not another line on the subject from me, or from any one else, shall appear here. George Eliot's *philosophy* is another matter; and in so far as it can be dealt with without touching on dogmatic religion may be freely considered.

I find much explanatory work provided for me by the lively "Hallyards," on my return to my own country. I will endeavour to be brief, not "otiose" as he finds me in one of my comments on his views: possibly "otiose" because I agreed with him. Anyway,—"otiose" is good.

I object to "Hallyards" saying simply that I wrote of him years ago that he was "by no means a fool." That would be only less offensive than saying he *was* a fool. What happened was this: "Hallyards," *more suo*, said he feared he had written like a fool, or "to that defect;" and *in reply* I remarked that he did himself injustice.

I must be allowed to maintain that I have never said space must be finite. "Hallyards" thinks I may have said so and forgotten it; because I have said many things and changed my opinion about some. As I only began to write when I was twenty-six years of age, and had very definitely formed my opinion about the question of infinity of space several years before that, nothing but deliberately saying that I thought what I never have thought could have brought about what "Hallyards" has imagined. I *know* I have never done anything of that sort. "Hallyards" does not consider my remark that we cannot conceive infinite space mightily different from what he ascribed to me—the definite statement that space must be finite. I differ from him. What I have constantly said about infinity—using the argument as an apt illustration of our position in regard to the question of Deity—has been this,—

1. Space must be either finite or infinite.
2. We cannot conceive space to be finite.
3. We cannot conceive infinity of space.

∴ 4. Space is a mystery beyond our powers.

I have used a similar illustration in regard to time. And then I have gone on to say, that since we cannot conceive the real nature of either space or time, both being utterly beyond our ken, how infinitely outside the range of our minds must be the nature and attributes of the Power working in and through all things, throughout all time.

It is not for me to explain how "Hallyards" has found in anything thus put the statement that space must be finite.

But it has just occurred to me that supposing "Hallyards" to possess not only a great power of taking things to pieces, but also a wonderful faculty for keeping the pieces apart, he may have recalled in such surprising piecemeal fashion, an account I gave in an article on

Infinity of the argument used first by Aristotle and quoted as "unanswerable but utterly unconvincing" by Sir John Herschel. Said Aristotle, Since whatever two points you take in space the line joining them is finite, space must be finite. I pointed out that the answer to this, which is in effect Euclid's first postulate, is found in the second, Any one of Aristotle's finite lines can be produced to any distance in the same straight line. This necessarily implies infinity; for it is only another way of saying that no line can be regarded as absolutely finite, seeing that every finite line can be extended.

As to stars moving in straight lines, if there were only two stars in the universe, and neither had any motion except on the straight line joining their centres of gravity, those two stars would move on that straight line till they came into collision. Otherwise *not*. The case *is* otherwise.

I MAY add, without entering into explanations, that—

1. No "clever one" has ever inferred from the probably rectilinear motion of the majority of stars that there may be collisions. "Hallyards" will find the passage he refers to in an article, quoted in KNOWLEDGE, by Professor Young. But it will by no means bear his interpretation. Professor Young spoke of stars not moving in closed orbits; but no one knows better than he that they cannot move on the absolutely rectilinear paths imagined by "Hallyards."

2. The earth would under no possible circumstances go off on a straight line, as "Hallyards" imagines.

3. The suspected companion of Venus is *not* supposed to have got loose in this way,—at least by any one knowing aught about the laws of motion.

4. The velocity of the solar system has not been determined at so many miles per second. On certain assumptions as to the distances of the stars of various orders a certain velocity may be calculated as probable. But the assumptions formerly suggested in this way have been negatived in more ways than one.

5. In any case, the sun's path can *not* be supposed to be straight. It is absolutely impossible that it should be.

6. Though (as I have shown) Mädler's idea of a central san has been disproved, the only positive evidence he advanced having been met by equal evidence pointing in a different direction, the non-existence of a central sun (also not proven) would not leave a single star in the galaxy free to move for ten consecutive seconds in an absolutely straight line.

"HALLYARDS" remarks that I have changed my mind on more points than one, and "Commentator" ("Hallyards" says) points out that I have flatly contradicted myself about the present habitability of the planets. Unquestionably I have changed my mind on certain subjects after more thorough study of them, or on hearing of fresh evidence. On the peculiarly speculative question of the present habitability of the planets my views are very different now from what they were when I first began to study the subject. But I have never changed my mind without carefully showing that I had done so, and my reasons. That is all a man can do (who wishes to act honestly) after a change of opinion; a man who has never changed an opinion is, of course, a man whose opinion has never been worth anything.

As for the "menacing comet," "Hallyards" appears to suppose I was the author of some article in the *Spectator* criticised—justly as he supposes—in the *Saturday Review*. In reality, I wrote an article in the *Cornhill Magazine* discussing Herr Marth's opinion that the comet of 1880 might return in 1897, and perhaps work mischief. I expressed the opinion that though the comet might seem to menace evil it would work none. This opinion I had defended and emphasised in a later article which appeared some time before the article in the *Spectator*, wherein some one (the editor, I believe) attributed Herr Marth's prediction to me, and showed that he had otherwise misunderstood me.

BEFORE leaving "Hallyards" I may remark, with reference to a subject which the acting editor very properly burked, that Kalekaua, King of the Sandwich Islands, informed me—at a meeting of a little Club of which I was president on board the *City of Sydney* in January, 1881—that but for the rite in question, the native population of the Sandwich Isles would come to an end within—say—ninety years, supposing that to be the greatest time any one now living there would last. This, said that profound and potent monarch, has been proved by abundant experiments, for which missionaries in the Sandwich Isles, who denounced the ancient ways of the islanders, were, in fact, responsible.

Reviews.

SOME BOOKS ON OUR TABLE.

Spectrum Analysis. By the late Dr. H. SCHELLEN. Translated from the third German edition by JANE and CAROLINE LASSELL. Edited, with notes, by CAPTAIN W. DE W. ABNEY, R.E., F.R.S. (London: Longmans, Green & Co. 1885.)—The history of spectrum analysis is full of instruction for the student of science. A hundred and thirty-three years ago Melville noted the monochromatic yellow-soda flame, and seventy years later Brewster gave Melville's idea a practical form in his monochromatic lamp. In the same year Sir John Herschel investigated the spectra of various-coloured flames, and some four or five years afterwards we find him saying "the colours thus contributed by different objects to flame afford in many cases a ready and neat way of detecting extremely minute quantities of them." In the year 1826, Fox Talbot, the father of British photography, examined the spectrum of the red fire of the theatres, and showed how its components were rendered perceptible by the various definite bright lines their spectra exhibited, going on to say, "If this opinion should prove correct, and applicable to the other definite rays, a glance at the prismatic spectrum of a flame might show it to contain substances which it would otherwise require a laborious chemical analysis to detect." As an example of prevision this is perfect. Talbot, Brewster, and Herschel alike erred in attributing the most familiar of all spectral lines, the sodium one, D, to water, thinking it incredible that any substance should be so universally diffused as we now know sodium to be. Later on, Talbot showed how strikingly different were the spectra of lithia and strontia—albeit the tint communicated to flame by both of these substances was the same. In 1845, the late Professor W. A. Miller gave maps of the spectra of the metals of the alkaline earths; and Professor Swan, in 1857, at last definitely showed the origin of the D line, and the astonishing delicacy of the Sodium reaction. The discovery of the new metals

Cæsium and Rubidium by Bunsen in 1860, and that of Thallium by Crookes about the same time is a more familiar story, as is that of Indium by Reich and Richter later still. So far we have spoken of the bright lines formed by the glowing vapours of heated substances: it only remains to speak of the spectrum of sunlight, in which we find them under a totally different aspect. At the very beginning of the century, Dr. Wollaston showed that the Spectrum of Sunlight (or rather of an excessively narrow line of it made by passing the Solar rays through a slit) contained some extremely fine hair-like lines, crossing at right angles to its length, and the year before the battle of Waterloo the famous optician Fraunhofer mapped no less than 576 of these lines. How finally Kirchhoff and Bunsen connected these two classes of observation, and hence enabled the terrestrial observer to determine the chemical constitution of the sun and planets, and even of the awfully remote fixed stars and Nebulæ, must be familiar to every one who has ever heard of Spectrum Analysis at all. As a popular account of this most important branch of scientific investigation at once full and accurate, Dr. Schellen's work is unsurpassed. Admirably translated and well edited, its description of the theory and practice of Spectrum Analysis, both celestial and terrestrial, leaves nothing to be desired. The results of the most recent forms of investigation are here given, but by the suppression of what is obsolete in the original edition of the work, Captain Abney has contrived still to keep it within the limits of a single volume. In thus praising the editing of this fine work, however, we should not be doing our duty if we did not invite attention to what we would fain hope is a piece of unintentional unfairness on his part on p. 342, in which, apropos of Janssen's observation of the bright lines of the Solar prominences with an uneclipsed sun, he lets the following words stand in the text without note or comment. "The achievement of Janssen was based upon principles already placed before the scientific world in a paper communicated to the Royal Society by Lockyer, in 1866." Turning to Vol. XV. of the "Proceedings of the Royal Society," p. 258, we find Mr. Lockyer saying, in the October of that year, "May not the spectroscope afford us evidence of the existence of the 'red flames,' which total eclipses have revealed to us in the sun's atmosphere; although they escape all other methods of observation at other times?"—a suggestion of identical value with that of the people who, during the last century, asked: "May not electricity hereafter enable us to communicate at a distance?" as placing "before the scientific world" the principles of the immortal invention of Wheatstone and Cooke. *Litera scripta manet*, and it is undoubtedly to our greatest living English spectroscopist, Dr. William Huggins, and to him alone, that the definite announcement of the method subsequently successfully employed by Janssen is due. On p. 88 of Vol. XXVIII. of the *Monthly Notices* of the Royal Astronomical Society we find:—

> During the last two years Mr. Huggins has made numerous observations for the purpose of obtaining a view, if possible, of the red prominences seen during a solar eclipse. The invisibility of these objects at ordinary times is supposed to arise from the illumination of our atmosphere. *If these bodies are gaseous their spectra would consist of bright lines. With a powerful spectroscope the light reflected from our atmosphere near the sun's edge would be greatly reduced in intensity by the dispersion of the prisms, while the bright lines of the prominences, if such be present, would remain, but little diminished in brilliancy.*

In the words which we have italicised in the above quotation the principle on which the spectra of solar prominences are seen in sunshine is stated in the most explicit possible manner. Let the impartial reader judge whether as much can be said for the vague and Zadkiel-like utterance previously extracted from the "Proceedings" of the Royal Society. Having said which, however, we have but little fault indeed to find with a work clearly, pleasantly, and instructively written, splendidly illustrated, and conscientiously edited. The woodcuts of comets and nebulæ might, though, be improved with advantage. A facsimile of one of Mr. Common's astonishing photographs of the great nebula in Orion forms the frontispiece.

Researches on Solar Heat and its Absorption by the Earth's Atmosphere. By S. P. Langley. (Washington: Government Printing Office. 1884.)—At whatever conclusion physicists may arrive with reference to the deductions drawn by Professor Langley from the results of the experiments recorded in the volume before us, but one feeling can be entertained as to the scientific value of the admirable work undertaken by him and carried out with so much zeal and devotion on his own part and that of those associated with him. The expedition whose work forms the subject-matter of his volume was undertaken to determine with the greatest attainable accuracy the amount of heat which the sun sends to the earth, and to this end measures made at the Allegheney Observatory during the years 1880 and 1881 were repeated at different heights on Mount Whitney, in South California, during the latter half of the last-named year. Inasmuch as it was necessary, for the proper conduct of the experiments to be made, that the observers should be situated in very clear air and have at least one-third of the atmosphere below them, the mountain just named was selected as fulfilling both these conditions, its height being between fourteen and fifteen thousand feet, and possessing, further, the special advantages of a dry climate and a very abrupt rise; its precipitous character enabling closely-contiguous stations to be found differing extremely in altitude. The instruments chiefly employed in the investigations were Pouillet's well-known pyrheliometer, the actinometer, and a curious and ingenious piece of apparatus, the invention of Professor Langley himself, which he calls the spectro-bolometer. Into the details of construction of these instruments it would obviously be foreign to the purpose of a review to enter. All we can do here is to give some idea of the results which Professor Langley contends that he has obtained by their aid. He commences by reminding us how it is generally believed that the extreme violet rays are not readily transmissible by our atmosphere, that about one-fifth of the light rays are absorbed and four-fifths transmitted, while the absorption grows greater and greater, the dark heat-rays being almost wholly absorbed. Hence, as is supposed, the heat entering our atmosphere as light, when converted into dark heat escapes with great difficulty, whence the atmosphere acts towards the earth as the glass cover of a hot-bed. This, however, our author declares to be a delusion, inasmuch as the atmosphere acts with a remarkable *selective* absorption; and that in reality the dark heat rays are transmitted the most freely of all, the transmissibility increasing throughout the spectrum as the wave-length increases! One remarkable result of this may just be adverted to. If the blue rays are thus disproportionately cut off, and the remainder of the spectrum in combination affects our eyes as *white* light, it follows that if we could get right outside of the atmosphere the sun would look very blue indeed. Moreover, Mr. Langley finally determines three "calories" as the probable solar-constant. This is another

way of saying that if the earth's absorbing atmosphere were annihilated the sun's rays "would raise one gramme of water three degrees centigrade per minute for each normally-exposed square centimètre of its surface"; which, for the benefit of those happily unfamiliar with South Kensington cram-books, may be translated 15·43 grains of water 5·4 deg. Fahr. per minute for every ·39371² inch of its exposed surface. If we are to accept Professor Langley's theory of selective absorption and carry it out to its legitimate conclusion, we shall arrive at some pretty startling results. Among them that Sir John Herschel was hopelessly in error as to the lunar temperature ("Outlines of Astronomy," pp. 284-5), which, so far, as he (*loc. cit.*) states, from "*possibly* . . . . exceeding that of boiling water," must—if Professor Langley's views be correct—be considerably lower than —200 deg. Cent., even under a vertical sun! With which astonishing statement we commend the careful perusal of a really remarkable work to every one interested in solar physics and meteorology.

The Asclepiad. By Benjn. Ward Richardson, M.D. July, 1885. (London: Longmans, Green, & Co.)—The observation which we have made above in connection with Mr. Trever's work, that it possesses a certain interest outside of that profession to which it is especially addressed, applies *à fortiori* to Dr. Richardson's capital quarterly magazine, inasmuch as it always contains more or less matter at once readable by and instructive for the ordinary man of science. In the present number an article on "Homeless and Nomadic Populations: their Sanitary Condition and Inspection," quite falls within this category.

Proceedings of the American Philosophical Society, Parts I., II., and III., for 1883. (Philadelphia: McCalla & Stavely.)—The first two parts of these "Proceedings" contain a variety of scientific papers of the type usually found in such publications, but the third possesses a peculiar interest, it being made up of the Old Minutes of the Society from 1743 to 1838. The astronomer will read with interest of the appointment and doings of the Committee to Observe the Transit of Venus in 1769. At the meeting on May 20, it was decided for "Ewing, Williamson, and C. Thomson to wait on Miss Norris, to request the use of her telescope." We wonder who Miss Norris was, and whether her telescope has survived her. Five heliotypes of the exterior and interior of the Society's buildings, and a sixth, which is a facsimile of a letter from Benjamin Franklin, are bound up in the volume.

Geometry and Gravitation. By Alfred Jukes Allen. (London: Abraham Kingdon & Co. 1885.)—All who wish to see the operation of the law of gravitation lucidly explained by geometrical methods should get this little book. The author incidentally shows how it follows from the doctrine of energy that if the velocity of a body describing an orbit about another at a given distance from it is the same in different orbits, the velocity at any other distance is also the same in all. His terminology is of the latest.

The Child's Pictorial. (London: Society for Promoting Christian Knowledge.) *The Little Ones Own.* (London: Dean & Son.)—Full of well-executed coloured pictures, and of tales and sketches adapted to the capacity of our nursery population, each of the publications named above must be eagerly looked for by its juvenile clientèle. The parent who wishes to gratify his tiny ones with a pleasure to be anticipated every month, but who is undecided which of these little magazines to choose, should buy both. They are cheap enough.

THE FACE OF THE SKY.

From August 14 to August 28.

By "F.R.A.S."

THE student will turn his telescope on the Sun whenever the sky is clear, to look for spots and faculæ. The face of the night sky is shown in Map VIII. of "The Stars in their Seasons." Minima of Algol will occur at 11h. 38m. p.m. on the 17th, and 8h. 26m. p.m. on the 20th. Mercury is an evening star, but is rapidly getting into an unfavourable position for the observer towards the end of the next fortnight. Venus is an evening star, too, and may be seen glittering over the western horizon after sunset. The rest of the planets are, as we said a fortnight ago on p. 97, invisible. The Moon enters her first quarter at 6h. 14·8m. a.m. on the 16th, and is full at 7h. 54·7m. o'clock in the morning of the 24th. Three occultations of fixed stars occur at convenient hours during the succeeding fourteen days. The first happens on the 20th, when the 6th mag. star B.A.C. 6,287 will disappear at the Moon's dark limb at 11h. 39m. p.m., at an angle from her vertex of 165°, reappearing at her bright limb at 12h. 35m. at a vertical angle of 272°. On the same night, eight minutes after midnight B.A.C. 6,292, another 6th mag. star will disappear at the dark limb at a vertical angle of 115°. It will have set ere it reappears again. Lastly on the 21st ρ^1 Sagittarii, a star of the 4th magnitude, will disappear at the dark limb 35 minutes after midnight, at an angle of 157° from the vertex of the Moon. As in the preceding case, however, its reappearance will be invisible. The Moon is in Virgo all day to day, leaving Virgo for Libra at 12h. 30m. to-morrow night. Forty-eight hours later, *i.e.*, 30 minutes after midnight on the 17th, she passes into the narrow northern strip of Scorpio, from which she emerges at 10h. 30m. the next morning (that of the 18th) and enters Ophiuchus. She leaves Ophiuchus for Sagittarius at 8 a.m. on the 20th. At 11h. 30m. on the night of the 22nd she passes into Capricornus, and from Capricornus into Aquarius at noon on the 23rd. At midnight on the 26th she enters Pisces. She is still travelling through Pisces at midnight on the 28th.

Thunderstorms of a violent character visited various parts of the country last week. At Northampton, on Wednesday, a young man named Soden was struck by lightning, his sight being injured. The West Berks district was visited on Friday by several terrific thunderstorms. The first occurred at about two o'clock in the morning, when the flashes of lightning were frequent and vivid, and the peals of thunder particularly loud. A second storm commenced shortly before midday, but the most serious storm broke over the district in the afternoon, when there was a heavy fall of hail, lasting some time, and doing considerable damage to the corn crops on several farms. A great quantity of rain fell, flooding many places. A heavy thunderstorm prevailed in the district of Aylesbury on Thursday night and Friday, accompanied by torrents of rain. In Hartwell Park, nineteen sheep belonging to Mr. Lee, which had taken refuge under a tree, were struck by lightning. Sixteen were killed on the spot, and the other three were so injured that they had to be slaughtered. A fire-ball, it is said, fell on Hartwell Vicarage lawn during a flash of exceptional vividness and a terrific thunderclap. In other parts of the district injury has been done. Some farm premises at Tring were struck. Birmingham was visited by a heavy thunderstorm, accompanied by drenching showers. The thunderclaps were exceedingly loud, and the lightning flashes very vivid. The storm lasted two hours. During a severe thunderstorm, accompanied by hail, which passed over Melton Mowbray, on Friday afternoon, two houses were struck by lightning. One, the residence of Mr. Robinson, a solicitor, in which three rooms were partially wrecked, and the other the shop of Mr. Smith, a jeweller. One of the most terrific hailstorms ever experienced in Warwickshire visited the Bedworth district on Friday. The hailstones were of enormous size, and the downpour lasted for a long time. Thunderstorms, accompanied by vivid flashes of lightning and torrents of rain, also prevailed in this district at intervals during the day. At Leamington a Mrs. Rouse was struck by the lightning, and rendered blind. On Saturday morning she was in an extremely critical condition, the electric fluid having burnt her severely on the head and face. The crops in the surrounding districts have been considerably damaged by the heavy rain. At Sheffield the storm lasted nearly two hours. It was accompanied by rain and hail, the former falling in torrents. The streets were flooded. Whilst the storm was at its height a main sewer in one of the hilly parts of the town burst with a loud report, tearing up the roadway for a number of yards and flooding houses and shops on both sides of the road. The water in the street was several feet deep. Damage amounting to £1,000 was done. A sewer in another part of the town also burst.

XUM

"Let knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE SUBJECTIVE NATURE OF THE OCULAR SPECTRA.

[1861]—The concluding paragraph of my letter (1815) on "The Variation in the Apparent Magnitude of Spectral Images" showed that I was quite prepared for the kind of surprise expressed by your correspondent, Jos. W. Alexander, at the exposition of the science of that subject; or, at least, at the statement that the ocular spectra have no objective existence. Mr. Alexander's letter does not, however, make it quite clear that he is intimately acquainted with the class of phenomena referred to, viz., those sequent sensations to any strong initial excitement of the retina those spectra which have no external objectivity, but which are either persistent sensations or complementary nervous reactions, although the mind of the observer is generally deceived by and attributes externality to them. These sequent sensations have doubtless been termed *spectra* by physicists on account of their absolutely visionary nature. It has already been demonstrated in these pages that colour itself has no external existence whatever as colour; and it might also be demonstrated that even the direct impressions produced by objective realities are but *spectra*—the mere ghosts of things—and that the proximate external causes of the imagery of the optic sense must, in some respects, be very unlike the sensations themselves. Even the causes of some kinds of ocular spectra are only very remotely external. According to Mr. Alexander's own showing, an observer may fancy he actually sees the sun when the sun is below the horizon and has no objective rapport with the eye; the spectrum of the sun in the eye of such an observer is impressed some minutes after that luminary has departed from the apparent position of that spectrum, the immediate cause of which is a telegram of rays, a fasciculus of vibrations, despatched the instant before the sun set. Moreover, any one may convince himself of the truth of the scientific position I am attempting to expound by submitting to be sun-dazed, after which he may turn his back upon the sun and gaze either on a light or on a dark surface, when he will experience a series of ocular spectra of the same magnitude as the original impression, but of different colours; he may also still further satisfy himself that these sequent spectra have no objective externality whatever, that they are merely subjective phenomena, by either closing or bandaging his eyes, for he will even then continue to see them.

My statement (in letter 1815) that the ocular spectra persist of "one constant magnitude" was too absolute, the spectra do change in magnitude as they fade. What I ought rather to have said was that the adaptation of the eye to vision at different distances does not affect their *actual*, but only their *apparent*, magnitude. I will touch upon some other interesting points connected with the phenomena of the ocular spectra in some future communication. W. Cave Thomas.

COMPOSITE PHOTOGRAPHY AND GENERIC IMAGES.

[1862]—It was stated in a former letter (1,739) that at the Antwerp Art Congress, about the year 1860, I proposed to demonstrate, by the presentation of a number of individual images of the same kind, in rapid succession to the eye, that the resultant generic impression would be more pleasing than any individual instance—to demonstrate by experiment, in fact, that the mean is the measure of the ideal, of the beautiful. To prove this, however, it is not absolutely necessary to have recourse to human forms, the fact can be as well illustrated by the use of geometrical figures; knowing the limits of differentiation of the ellipse, we are enabled to experiment with a series of ellipses, or even with colours, instead of portraits. At the Congress referred to, I proposed to use—nay, did use—similar means to those which have been adopted, time out of mind, for demonstrating, by rapidly rotating a disc before the eyes, that the prismatic colours, being successively excited on the retina, produce a mean impression, or the sensation of white. As the subject of the production of generic images has been again broached in these pages, I beg leave to suggest to experimentalists, to photographers, means for perfecting the process. To this end a zone of portraits should be mechanically constructed to gyrate round the camera, and to pass steadily and evenly before the lens. This would permit of a series of portraits being nicely adjusted prior to their presentation to a sensitised plate. A number of sitters might even be posed and presented in succession to the camera, but to accomplish this successfully the camera itself should be contrived to revolve. The subject of generic images was treated in a paper of mine read some years since, at a Congress of the British Association for the Advancement of Science. W. Cave Thomas.

INFINITE OR INDEFINITE?

[1863]—May I suggest that a great deal of confusion of thought would be got rid of if, instead of speaking of atoms as *infinitely* small, we were to use the words *indefinitely* or *indeterminately* small. An infinitely small thing has no parts or magnitude—is, in fact, nothing—has no existence. A million times an infinitely small thing is still infinitely small. That we say $\frac{\infty}{\infty} = 1$ merely means that when the numerator and denominator of a fraction are alike its value is 1.

Assume that an atom is to a grain of sand as a cherry is to the earth. Yet a cherry is divisible, and has a peculiar structure. Possibly atoms have in like manner a form and internal structure which may account for their behaviour.

By describing atoms as indefinitely small we merely express our ignorance of their size. An indefinitely small thing that has parts and magnitude is infinitely larger than an infinitely small thing.

E. W. Young.

DARWINISM.

[1864]—It certainly seems to me that Darwin's theory was that, no matter what caused the variation, it was perpetuated by natural selection. He never allowed that it was the nature of a certain species to vary in a certain direction; in fact, that rather was the theory of his opponents. Darwin did not deny that other causes besides natural selection might have produced certain species, but he maintained that natural selection had produced most species, and he endeavoured to show how. I have not his books before me, but, as far as I remember, the conclusion he came to was that man was descended from some marsupial [??] animal through an animal, not unlike our old-world monkeys, which in its turn was descended from a lemur-like animal, and so on back to the marsupial animal which was the progenitor of all placental mammals; and that all existing species were derived from one or two, or certainly very few types. It is some time since I read his works; but, as far as I could understand the question, it seemed to me that the difference between Darwin and his opponents was not the theory of evolution nor of survival of the fittest, but whether the original number of types was very few, or as many, if not more, than at present. Darwin said in effect all the quadrumana are descended from a single pair, all the carnivora from another pair, and so on. He also said all placental animals are descended from a single pair of marsupial animals; all vertebrates from a single pair, and so on. For his arguments, his works must be read. His opponents did not deny evolution, did not dispute the weight of many of his arguments, but they maintained that the original number of types, instead of being fewer were more than at present. It was not maintained that each species was produced ready made, but that, except in the case of very nearly allied species, each species had a separate beginning. Unless it is admitted that life first arose on this globe in some miraculous way, it seems most illogical to suppose that once, and once only, has inorganic matter become an organism. For this is what Darwinism, carried out to its logical conclusion, means. If, as Professor Tyndall explained in his famous Belfast address, organic life is merely the result of the condensation of matter, we are certainly justified in supposing it to have occurred or originated in many parts of the globe's surface, and possibly to be originating in some parts now. There seems also no reason for supposing that

the protoplasm formed should in every case be identical. Until we can trace back the lion and man to a common progenitor we are perfectly justified in coming to the conclusion that each is the result of a separate mass of protoplasm. If we require a common mammal progenitor for all the species of mammals, it seems to me we should require such a length of time for one to develop into a platypus, a whale, and a man, that the palæontological history of the globe would not satisfy the conditions; in fact, it seems to me, *ceteris paribus*, it would take longer for such a mammal to develope into the three species than it would take three masses of protoplasm to do.

What has always struck me as noteworthy is that each division of allied animals develops much the same varieties. Thus we have four-handed animals with long tails, and short tails, with no tails, and with prehensile tails. So we have flesh-eating animals with long tails, with short tails, with no tails, and with bushy tails; gnawing animals with all kinds of tails; ruminants with all sorts of tails, from the tiny tuft of the antelope to the fleshy appendage of the Dumka sheep. Take smaller groups of animals, dogs or cats, it is the same. Tails, we may consider, therefore, are, so to speak, common property. But, on the other hand, teeth seem to vary but little in allied species. Take, for instance, the rodents. The beaver uses its teeth to cut down trees, the squirrel to crack nuts, and the rabbit to eat roots. Which has acquired the teeth by its habits, or what were the habits of the common progenitor? But, if there was a common progenitor, it must have had the distinguishing teeth. Then, again, the carnivora all possess similar dentition, in spite of the different habits of the bear, the lion, the weasel and the hyena. We must imagine the common progenitor to have had similar dentition. If so, a geological period ago the common progenitors of the rodents and the carnivora respectively were as separate types as a rat and a weasel of the present day. Take, again, the position of the mammæ. The progenitor of the ruminants surely had them where every ruminant has them now; the first carnivorous mammal where every carnivorous mammal has them now. The marsupials do not help us, for the kangaroo has them much in the same place where they are situated in man and the higher apes, which position is supposed to have been acquired because man and apes nurse their young in a sitting position. But is it not possible they do so because the mammæ are so situated? A cat must lie down to suckle its young, a cow must stand up, and a monkey more or less support its youngster in its arms. I cannot see how it is possible to conceive an animal so far developed as a marsupial mammal which could, except by inadmissible leaps, vary into the different forms of mammals existent. Is it not more reasonable to suppose that each mass of protoplasm, as it came into existence, began varying in one direction or another according to circumstances? Is there, in fact, such a thing as a cradle of the human race? Is it not possible that when man first assumed humanity he was just as much scattered as the Simiadæ are now. The antiquity of man has been proved to be so much greater than was formerly supposed possible, that the veritable Adam must have existed before the Eocene period; but even then he may have been scattered about and not represented by a single pair. Jos. W. Alexander.

[The reasoning in Mr. Alexander's letter may be to some degree met by the consideration that Darwin nowhere speaks of the single pairs imagined by Mr. Alexander. The whole doctrine of evolution as taught by Darwin is inconsistent with even the bare possibility of a single pair being the progenitors of a new species. Mr. Alexander should go to Darwin's books for Darwin's ideas—as well as for his facts and his arguments.—R. P.].

SURVIVAL.

[1865]—In Feb. last I wrote in *K.* that even a gorilla would laugh at the teaching that man could not have survived without language, association, and weapons. I have not as yet had any overt adhesion to this sentiment on the part of this family; but I have got a long way towards it, in the spontaneous declaration of a Bechuana chief, reported in *Pall Mall Budget*, July 10th, p. 10. "Sechele spoke against the Protectorate. Who wanted it? He did not. It was true they were not strong, and they were surrounded by enemies, but so was the steinboek; *it was weak and small and had many enemies, and yet there were always steinboeks.*"

Pray nail this new trapping on to my hobby. Hallyards.

BIG BIRDS.

[1866]—The other day an eagle was shot in France which measured 1 m. 80 c. from tip to tip of wings—nearly 6 ft. An eagle has a body not so large as a turkey's; I think an average eagle does not sit over a foot high. The ostrich stands 6 ft. high sometimes; the great nuisance of ostrich-farming is that the birds can claw a man down by raising a foot to his shoulders. If the ostrich had wings bearing the same proportion to its body as the eagle's, it is clear that these would be 36 ft. across. If there are condors with bodies as big as the ostrich's, they may, therefore, well (in rare cases) measure 40 ft. from tip to tip.

Hallyards.

THE PHILOSOPHY OF ETHICS.

[1867]—If it is true, it is indeed sad to think that the world is in danger of coming to an end. It is implied in 1828 (*sic*) that morality will be annihilated, involving not only the reversion of the human race to a wild, anti-social state, but their actual extinction afterwards, along with the other mammals and birds—since the duties of parents to their helpless offspring will cease to be recognised.

There is, however, really no fear of a catastrophe, either moral or physical, taking place. "Meter" apparently has not read the papers on morality that appeared in Knowledge about a year ago. Had he done so he would have seen that morality did not necessarily depend on theological notions; in fact, a far higher standard of morality may be deduced from other principles.

In the same letter an extraordinary use is made of Dr. Lewins' doctrine, which throws doubt on the existence of an external world. "Meter" would apparently deduce "orthodoxy" from the premises of the sceptic—the very antipodes of Dr. Lewins' conclusions. The two schools of philosophical sceptics may well be left to adjust their own differences.

It is very true, as Renan says (quoted in 1833), that very few have the right to reject Christianity. (The proposition has also a reverse, which one need not enunciate.) It obviously follows that equally few have a right to determine who belong to the elect number. I do hope "Hallyards" is among the elect, but the curious manner in which he would determine who are sheep and who are goats makes one doubt of him. Why should he exclude all women from participation in the paradise of those who have a right to reject Christianity? Renan's own sister would thus be excluded, to whose memory such a fine tribute is paid in the dedication of the "Vie de Jésus."

The question, stated in general terms, is really, "Who have a right to form their own opinions on religious and philosophical matters." To discuss this fully would require a long letter. We can only say here, that those who use and cultivate their thinking powers have a better right to form their own opinions on religion and philosophy than those who neglect their thinking powers, however much the memories of the latter may be crammed with "learning." It would probably be too much to ask some of the correspondents of Knowledge to study Mill's "Logic;" if, however, they mastered the work, I am persuaded they would considerably modify some of their views. On the other hand, it is only fair to add that Luther had the most thorough contempt for reason. Having exhausted the whole vocabulary of permissible expressions, he had recource to such language that his condemnation of reason cannot now be repeated. Probably, however, if Luther's followers and others had been more reasonable, the Thirty Years' War might have been avoided.

As regards George Eliot, few, I think, have had a better right to form their own opinions on religious matters. She translated Strauss's "Life of Christ" and Feuerbach's "Essence of Christianity," and was thoroughly conversant with all philosophical and scientific questions. T. Common.

THE CHANNEL FEAT.

[1868]—Few things have surprised me so much as the collapse of two of the Oxford crew. I have crossed that water some forty times, and, on the most blazing day, always felt the need of some wrap. Again, I always was somewhat of a weakling; yet when 21, refused insurance for heart-disease, I one evening took a dingy at Oxford, and rowed to Abingdon and back, between six and twelve p.m.; from Nuneham to Oxford I took in a friend, dead weight; no food from twelve to twelve, though beer and claret-cup. The next autumn I "stroked" a fire-engine—five besides myself—without a moment's rest, from ten p.m. to four a.m. The only result was an internal fire, quenched only by a whole quart of Guinness at one draught, in one big glass. I offered to row from Dublin to Ballinasloe in one day—seventy miles by the canal, I think—but found no takers. Galley-slaves used to row often twenty-four hours stark naked. Hallyards.

PHILOSOPHY OF CLOTHING.

[1869]—I am glad to see that Mr. Ollard (1851) has practically discovered the benefit of adopting those principles of clothing which Mr. Mattieu Williams in these columns, and I myself otherwhere,

XUM

especially in the *Queen*, have been endeavouring for some time past to explain. The health-value of woollen materials is not sufficiently appreciated, and it is desirable that not only the public who demand clothes, but also those who make it their business to supply them, should be better informed on this point. In this connection I am pleased to be able to say that my own tailor, Mr. T. W. Goodman, of Albemarle-street, W., is as ardent a believer in wool as Mr. Williams and myself, and the excellent tricycle dress for ladies which he has invented is lined throughout with flannel. Besides this, he lines both ladies' and gentlemen's clothes with woollen materials when his customers will consent to this proceeding, to which, however, he informs me many people are opposed, as people always are opposed to anything that is new to them, however good it may be.

ADA S. BALLIN.

A "CLERICAL ERROR."

[1870]—The Dean of Llandaff, preaching on the *Pall Mall* turned Apostle, spoke of "a mercenary and murderous traffic, in comparison with which the old North-West Passage was but the 'light affliction which is but for a moment.'"

I started, as torpedo-struck.* My father spent four winters without sun, helping to discover the N.W. Passage to India,—reward, £20,000. What could the Dean mean? There never was any "traffic" by that glacial route. Oh! I have it! "The horrors of the Middle Passage"—*i.e.* slaves between Africa and America. A "nice derangement of epitaphs," indeed. Let us hope the tombstones of Llandaff are better ordered.

HALLYARDS.

THE EPITHALAMIUM.

[1871]—Shall I again draw "R. A. P." on my knuckles if I hazard a remark on the latest *poemation* of the Laureate?

Taking a reckless header from off this Third World (easy enough, since an inital velocity of more than twelve miles per second would carry one clear of its attraction—and *thought* goes quicker than that)—Lord T——, like the proud Assyrian of old (Is. xiv. 13, 14), has struck the stars. But either I misapprehend the details of double-star systems, or he does; or, at any rate, he gives a misleading notion of them.

I have always understood that a planet in such a system must have one or other star for a primary. In that case the other would, of course, cause a perturbation in the planet's orbit, but its influence would be insignificant as compared with the primary's (and this is uncomplimentary to *either* the mother or the husband), for the reason that, if not, the primary would cease to be its primary altogether.

"Sway'd by each Love, and swaying to each Love,
Like some conjectured planet in mid heaven
Between two Suns and drawing down from both
The light and genial warmth of double day."

So far as language goes, this would give me the idea either of a planet swinging *to and fro* like a pendulum, never completing a revolution; or revolving round *both* suns, which would be, I suppose, the foci of its ellipse. But, given the distance necessary between two such large bodies, what an improbably large planetary orbit—if possible, even.

Leaving, however, the dynamical question, I think that the Oriental lines on "may your shadow never grow less" would be a rather left-handed compliment if it implied life in a double-star planet. Suppose our sun had a primary large enough to appear, in spite of distance, as large as himself—how could any sort of seed-time and harvest-time go on? If animal life were tolerable when the two suns were in opposition, then it would be impossible when they were not so—a double amount of heat being received. Conversely, if animal life were tolerable with both suns up, then it would be intolerable from cold with only one. On the whole, bad as our poor third world in many respects is, it may be better "to bide wi' the diel ye knaw, than to gane to the deil ye dinna knaw."

"Sway'd by each Love, and swaying to each Love."

I presume that these different participles express the, first, involuntary attraction; the second, voluntary motion towards. If so, the simile is broken, since a planet has no will.

"Mid-heaven" must, I think, mean, not the sky as seen by us, but the region half-way between the two stars; which again indicates the impossible theory—

"Which from her household orbit draws the child
To move in other spheres."

This seems to me imperfect. The expression "to move in a sphere" is neither scientific nor poetical, but rather vulgar. I suppose it hails from the imaginary concentric spheres of the Ptolemaic astronomy. Bodies, however, do not really move in spheres; and I guess that the Laureate never would have thought of it if he had not been astronomically inclined, and so tempted to use an astronomical word, though in quite an improper relation.

In conclusion, I have myself tried the double-star system of matrimony, and am of opinion that a better metaphor would be a shuttlecock between two battledores. Keep up the game long enough, and all three are worn and misshapen.

Lest some one should suppose I am Vandal enough not to like Tennyson, let me add that I think him far above Shakespeare as to form, and not far behind him in substance. I abjure "In Memoriam" as I do the telescope; they both would keep me up at night. If, therefore, I find the last song a little feeble and mawkish, it is surely not from prejudice.

HALLYARDS.

* I have found numbers of people quite ignorant of the real, natural torpedo—now quite eclipsed by the craft, not so happily named, after all—for the eel does not blow his victims into smithereens.

THE RECENT CORRESPONDENCE OF "HALLYARDS."

[1872]—Your correspondent, "Hallyards," in his letters on Evolution puzzled me somewhat until his letter 1767 confirmed my previous suspicion that he had no clear idea of what "Evolution" really teaches. It was satisfactory to find that he wished to investigate the matter, but it is to be regretted that the speculative element in his nature had led him to criticise, and argue the point with, your able writer, Miss Ballin, before having made himself acquainted with the principles of Evolution. He also asks you to publish articles giving all that has been *established* on this subject. I do not think such a short cut would be of any use to him. You can look at established conclusions without understanding them in the least; the important thing is *how* they have been established.

In letter 1763, he says he never could sympathise with the cock-sure. This is amusing in the light of the correspondence with Mr. Proctor, in which he reasserts that Mr. P. did say that which he disclaims; also in letter 1882, in which he states that Miss A. B. Edwards' chronology was *totally impossible*; and again in letter 1833, where he denies that George Eliot was one of the very few having the right to reject Christianity, for the simple reason of her sex. Surely this is dogmatism extraordinary. (Oh! for the power of seeing ourselves as others see us.)

Women admit they do not reason but feel, he says. What has that to do with individual women who do reason, or who are capable of understanding reasons when they are put before them? Moreover, what is there to prevent a woman being convinced by the reasons supplied to her by one of the "Lords of Creation," and afterwards asserting that conviction? In the postscript to letter 1779, "Hallyards" thinks that "St. George Mivart has admitted that special creation of man is not of the essence of Christianity." And clearly if evolution be true, even to the limited extent of man and the different orders of the quadrumana having been evolved from the same primitive stock, there cannot have been a special creation of man. In letter 1816 he says "the standard of morals is always fixed by the laity," and, again, in letter 1833, he harps upon the same string. "The sole standard of conduct for individuals has always been the rule settled by the society of which they form part." And then—he gives a string of illustrations which show what an enormous moral gain it would have been for women to have utterly disregarded their society's standard of morals. These illustrations altogether upset his argument. According to his contention, the wife of Luther must have done a very wrong thing in marrying him, or a Continental officer refusing to fight a duel with another officer must also be doing a wrong thing. I utterly repudiate this absurd doctrine. Some of "Hallyards'" letters are interesting, but I wish he would abstain from Latin quotations, considering that KNOWLEDGE is supposed to be plainly worded and exactly described.

ROBERT WOOD.

[1873]—I wish to thank "W." for his (unless one of the other genders be more correct) spontaneous offer to do what I was wishing to do for myself, *i.e.*, index my letters. I meant to suggest to you, sir, that a double correspondence index would be a most useful addition to KNOWLEDGE, (1) the correspondents in A B C order; (2) their subjects in ditto. Of all the faults that can be found in a writer, I certainly think the charge of versatility is the most extraordinary. Fancy an editor inscribing over the correspondence columns:—"N.B. No versatiles need apply." "Fear the man of one book," said the schoolmen. "Insist on the man of one book," says "W."

Surely "W." has got the wrong walrus by the ear. At least, if I chanced on so well-bred and well informed a creature, I should chum with him far more gladly than with some others hailing from the same litter.

"W." *might* have quoted two lines which really would have rather hit me on the raw:

"Græculus esuriens, in cœlum, jusseris, ibit
Augur, schœnobates, medicus, magus, omnia novit."

But it is hard in paper war, as in others, to have to put the shot in one's opponent's guns.

I never said that my father, though an "Ancient Mariner," had "shot the albatross"—in this case the condor—nor that *he* had "called the lands after his own name."

Perhaps, after all, my need for index may be obviated by gathering my letters into a volume, "Letters of 'Hallyards,'" the Junius of the twentieth century. "Who was 'Hallyards'?" The Conductor of KNOWLEDGE, and its Editor (himself a veiled prophet) passed hence and made no sign—they alone were in the secret. The only material evidence is a few scraps, bearing French stamps, found in an old waste-paper basket (purchased at its weight in coppers). Why did he sign these? Is it the halyards of a ship? Clearly so—R.N. origin; but then, why not binnacle, or bowsprit, or flying-jib? From internal evidence, one will prove that "H." was Mr. Bradlaugh; another, Cardinal Newman; a third, Lord Shaftesbury; while a fourth will establish beyond all doubt that no one but F. C. Burnand could have written letters containing so many Happy Thoughts. HALLYARDS.

LETTERS RECEIVED AND SHORT ANSWERS.

H. O. DOVE. Last year my own bees and those of all my neighbours produced curiously-dark and discoloured honey. This was universally attributed in my own neighbourhood to the honeydew and concomitant "blight" on the plants frequented by the bees.—J. S. There are no such tables as you ask for, but you may make the calculation for yourself, most simply, thus: Divide the circumference of the earth's orbit in miles by the number of seconds in one revolution, which will, quite obviously, give the length of the arc described in one second. For our purpose we may consider this arc and its chord as coincident. Now, by geometry, twice the radius vector of the earth's orbit : this chord :: chord : distance through which the earth falls towards the sun in a second. See also Chapter II. of "The Sun," by the Conductor of this journal.—J. R. L. Your letter will be handed to "Five of Clubs" the moment he returns to England.—CHAS. J. MABERLY. Wholly needlessly detained through being addressed to the Editor instead of to the *Publishers*.—DR. LEWINS. Received; but you merely reiterate what you have said x times previously.—E. G. S. In reply to you on p. 59, I, in some occult way, entirely forgot the existence of Brande's "Dictionary of Science, Literature, and Art." It is a rather costly work in three volumes, and is published by Longmans.—R. R. ORLEBAR. Had the comet recently discovered by Barnard been fairly observable with any moderate telescope, or possessed the slightest popular interest, I should have at once requested "F.R.A.S." to furnish a descriptive article upon it. When discovered, it was described as "not more than 1′ in diameter; 11th magnitude or fainter (!), and as having some central condensation, but no tail." It is travelling rapidly south, and its theoretical intensity of light is decreasing. At its brightest, it was *imperceptible* in any telescope of less than 2½ inches aperture, and could not be fairly *seen* save in a large one.—SLIM. Any exercise "three minutes' moderate practice" of which is "generally succeeded by bringing up a little blood from the lungs" should be discontinued forthwith. Try the work reviewed on p. 52. You may certainly increase your present very defective chest measurement by properly-regulated exercises, such as was described in the book referred to.—W. H. GREENE. Your extract from "Old Stones" is in no legitimate sense whatever an answer to the theory of Evolution. In fact, it is simply a begging of the entire question. It is certain that for one fossil orm of life that has been preserved unnumbered millions have been destroyed. The hard frame of a crustacean like the trilobite may, under certain circumstances, be preserved; but, considering the conditions of formation of the earlier strata, the marvel is at even traces of that have not all been obliterated. Do you expect to find casts of the soft bodies of Ascidia in metamorphic rocks (!)? With reference to the advertisement of which you speak, see the note beginning p. 72.—W. TAYLOR. There is nothing to prevent you from teaching yourself enough both of chemistry and electricity to furnish you with a perennial source of amusement and delight. If you can afford it, get Roscoe's "Elementary Lessons in Chemistry" and Thompson's "Elementary Lessons in Electricity and Magnetism." They are published at 4s. 6d. each by Macmillan & Co. You need not, however, confine yourself to these two branches of investigation. Obtain and carefully read Tomlinson's "Introduction to the Study of Natural Philosophy," an admirable little eighteenpenny book which forms No. 2 of Weale's "Series," published by Crosby Lockwood & Co.—LUX asks for "the titles of works, &c. (or of the pictures themselves) containing pictures and illustrations teaching moral truths and lessons learned from the study of good and evil as a science." Surely nothing surpasses Hogarth's works for this purpose?—REV. G. HOWARD WRIGHT. Is not the discussion of the Licensing Laws a little foreign to the purpose of a journal devoted to the exposition of popular science?—T. BOLAS AND W. K. BURTON. It would simply waste space to discuss your wholly Utopian scheme here. Any attempt to confiscate property *legally* held (whatever the moral aspect of its original acquirement may have been) in this country could only lead to civil war, in which the army, navy, police, and the overwhelming majority of the Volunteers would be found ranged on the side of law and order. How many weeks is it since a number of Socialists in the great French Republic had the bayonets of the troops in their stomachs in the streets of Paris?—W. M. K. You are apparently under the illusion that you prove a statement by merely *reiterating* it. If everything is to be abolished which "does mischief," the law of gravitation, *inter alia*, will have to go, inasmuch as it is by its operation that the wretched hodman, should he make an unfortunate slip, falls from a five-story scaffold, and is smashed to pieces. It is a gross and scandalous libel upon the millions in this country who habitually take alcohol in strict moderation to say that their temperate consumption of what undoubtedly benefits them "leads to drunkenness." If any habitual drunkard becomes a nuisance to himself and to society generally, by all means legislate for having him locked up like any other lunatic; but don't talk nonsense about the hard-working labourer consuming his well-earned pint of beer. I read Lord Wolseley's speech at the Mansion House, and a very sensible one it was. The same amount of alcohol which is not only harmless, but positively beneficial, in temperate and cold climates becomes hurtful and injurious under a semi-tropical sun; just as a too strictly carnivorous diet does. Spirits, with the thermometer at 98 in the shade, are apt to be injurious. Speaking for myself, I never touch spirits from January to December in any form. Wine, though, and beer—to a small extent—I do take, and, *pace* the hysterical shriekings of the total abstainers, shall continue to take. You say that so-and-so "has been proved over and over again," when all that you really have the slightest right to predicate is that it has been so *asserted*. Your "most of the leading athletes of the world" statement is another example of utterly reckless assertion. I have heard of Edward Payson Weston. Favour me with only six more names. As I may assume as absolutely certain that the opinion of a medical man of such indisputable eminence as Sir James Paget will have more weight with nine hundred and ninety-nine thousandths of rational men than any mere fanatical statements unsupported by proof, I will, in conclusion, quote what he says on the subject: "I would maintain this, and all that can reasonably be deduced from it, namely that the best, and in proportion to numbers, the largest quantity of brain work has been, and still is being, done by the people of those nations in which the use of alcoholic drinks has been and is habitual. Further, I would maintain that, so far as I can judge of the brain work of different persons, they have done best and most who have habitually and temperately taken alcoholic drinks." REV. S. T. B. PEPPIN.—I certainly did only read your letter through once (amid a score or so) but I as certainly imagined that I had mastered the sense of it. I can only regret to find that I have misinterpreted you, and that, for example, what I took for antithesis in your expressed idea concerning shutting our Bible and opening our Darwin was not intended by you as such. No apology is needed for the use of an "elegant expression" employed by Shakspeare, Dryden, Sydney Smith, &c. With reference to your peroration, may I ask you kindly to read, mark, learn, and inwardly digest an article which appeared on p. 475 of Vol. VI. of KNOWLEDGE.—ANONYMOUS (Bristol). I do not know Mr. Edwin Wooton's address, and am hence unable to forward to him (what feels like) the tin canister which you have directed to him at Messrs. Wyman's.—C. D. COLLET. Undoubtedly a tax on locomotion is an evil; but so, in some sense, is every tax. Sad experience of English railways generally (and notably of the Southern lines) might convince anyone that, if the travelling-tax were abolished to-morrow, the *passenger* would derive no benefit from it, as the companies would take exceedingly good care to pocket the money. But the columns of a scientific journal are not the place to discuss this question in.

THERE are now 1,045·5 miles of water mains within the metropolitan area that are under constant pressure.

THE Manchester Ship Canal Bill has been read a third time in the House of Commons. The scheme has been before Parliamentary Committees no less than six times.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

WASHING-MACHINE.

This machine, invented by Mr. Harmens, is as simple as it is said to be effective. No rubbing is required, and the use of washing-powders is avoided. It consists of a strong tinned iron case, with copper bottom and extra loose bottom fitting easily in the outer case. When required for use the loose bottom is taken out of the machine, and half a pound of soap, cut into two or more pieces, is put in; the loose bottom is replaced, and, the machine being filled with water to the height of about four inches

on the double bottom, it is placed on the fire. The linen, which is first thoroughly soaked, is wrung and placed in the machine (taking care not to close up any of the holes in the tube), and left for half an hour on the fire. The machine is then removed from the fire, and the contents poured into a tub and well rinsed. If necessary, the machine is again prepared as at first, and again heated for half an hour, and the linen will, it is claimed, be perfectly soft and white, without having received any injury in the washing. The circulation of the water produced in this apparatus is its feature.

LIFEBOAT.

[Patent No. 4,411. 1885.] This boat, invented by Mr. James Wright, of 97, Lucey-street, Bermondsey, S.E., is designed and constructed to right itself with sails set and sheets fast, discharging the whole of the water shipped in 23 or 24 seconds. Her lines are straighter and shear much lower than that of other self-righting boats, making greater speed with head to wind. She has been thoroughly tested at Brighton, Ramsgate, and Margate: and also, previously, in the West India Docks and the Thames, manned with miniature weighted model men, and afforded great satisfaction to those present. The chief novelty of the invention, patented, is the peculiar construction of the fore-and-aft air-tight compartments, without which no boat with "sails set and sheets fast" can right itself.

SASH-FASTENER.

[Patent No. 535. 1885.]—This is a simple, but ingenious, invention by Colonel Henry, of 35, Stanhope-gardens, S.W. The object is to overcome the trouble and inconvenience incident on replacing a broken sash-line (where the ordinary fastening is adopted). Fig. 1 is a perspective view, and Fig. 2 a front view of the fastener. To

Fig. 1.

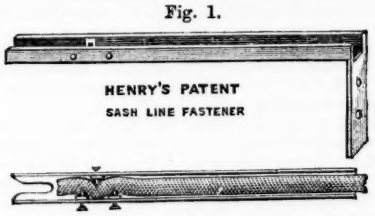


Fig. 2.

fix it, take the sash-frames out in the usual way by removing beading; rip the old sash-line off, taking out all nails. Fit the fastener to the existing slot in frame; the fastener must fit the groove or slot easily, care being taken to keep the fastener in centre of sash bar. Countersink top of sash bar to allow flat top of fastener to go in flush. When accurately fitted put a screw into the slot of frame through the fork of fastener, about midway, and turn the screw down until the head nearly touches the fork. Now take the fastener out and place one end of the new sash-line in lower end of fastener, as shown in Fig. 2, by means of the three screws, which will now hold the rope or line quite firmly, and the fastener can be screwed down to the frame. The sash-frame should now be put back in its proper position, the other end of the rope passed over the pulley, and fastened to weight in the usual way.

When a rope or sash-line breaks where these fasteners are used, it is only necessary to unscrew the top screws, take out fastener, put in a new rope, slip the fastener down the slot again, and screw down to sash-bar.

Our Parador Column.

"TIME'S UP!"

Editor,—Dear Sir,—How it happens that the "P. D," writings mises your wast paper basket, I cannot tell. If it is simple foreign matter in the Basket,—what kind of matter is paradoxical matter,—if it is so seemingly absurd, and, yet true in fact,—it surely must be the same kind of matter that the great Roman orator failed to express. "It is difficult," he said, "to define Time." St. Augustine, too, confessed his inability; "If no one asks what Time is, I know it; but if you ask me to explain it, I know it not. "and some one else has said, If you do not question me, I understand it," we ought to know something about—that—mysterious principle which operates on every thing, and yet touches nothing. (Time is only a fictitious scale, to show the durability or duration of matter in motion. The same when scientific men speak about the—constitution of Time—weight of matter in motion as a gravitating Body. Therefore the weight of gravity is only the weight of Time.). Time is every thing, and every where. some say; we live in it, and move in it, and within its period we have our being. Without we understand Time, we know—nothing, —to think about the moon been made of green chease,—or the Sun been once or is red hot seems all bush to me.

Yours Truely

Angt 3rd 1885 J. Murray.

[Mr. Murray is too modest. He surely does not send "the 'P.D.' writings" to Knowledge for the purpose of insertion in my "wast paper basket"?—Ed.]

A Fatal Error.—Two male patients have, says the *Lancet*, been poisoned in St. Louis Hospital, Paris. The pupil in the dispensing department sent poison up to the wards instead of the mixture which was ordered. The dispenser, on becoming acquainted with the deplorable result of his carelessness, attempted to commit suicide, and was only restrained from affecting his purpose by the exercise of considerable violence on the part of the other students.

From the Report and Pass-List of the Technological Examinations held by the City and Guilds of London Institute in May last, we gather that no less than 3,968 candidates presented themselves, of whom, however, 2,168 only, or some 55 per cent., succeeded in passing. Some of the examiners speak of a satisfactory improvement in the character of the papers submitted, but there is much more "damning with faint praise" (to say nothing of actual fault-finding) than seems quite desirable.

Our Chess Column.

By Mephisto.

THE SCOTCH GAMBIT.

THE following three examples of the Scotch Gambit are games played last week in the tournament of the Counties Chess Association, at Hereford. Being all played by strong players they will serve as an illustration of the many dangers besetting even the best players in this Opening. We, however, wish our readers to understand that there is a safe way of replying to those particular variations of the Scotch Gambit (the only one which seems to hold out some promise of an attack for the first player is 7. Q to K2). As, however, we have determined only to proceed by way of illustrations from actual play, we shall wait until such a game has actually been played.

ILLUSTRATIVE GAME No. 4.

White. Blackburn.	Black. Gunsberg.	White. Blackburn.	Black. Gunsberg.
1. P to K4	P to K4	7. Q to Q2 (*a*)	Castles (*b*)
2. Kt to KB3	Kt to QB3	8. Kt to Kt5	B × B
3. P to Q4	P × P	9. Q × B	Q to Q4 (*c*)
4. Kt × P	B to B4	10. Kt to Q2 (*d*)	P to QR3 (*e*)
5. P to QB3	Q to B3	11. Kt to B3	Q to R4
6. B to K3	KKt to K2	12. Kt × P, and White won.	

Notes.

(*a*) This move has given a fresh impetus to this Opening. White threatens Kt to Kt5, as the P on B7 is weak.

(*b*) B × Kt leads to an even game. But P to Q4 may also be played.

(*c*) This move is based on a misconception. If White now plays 10. P to KB4, Black has a valid reply in Kt to Q4. But, as may be seen, White has a better move at his disposal.

(*d*) Threatening to attack the Q by Kt to B3.

(*e*) In reply to P to Q4 White would play P to KB4, as the P blocks the square on Q4 for the Kt. In reply to P to B4, White would likewise play 11. P to KB4, for, if Black then plays Kt to Q4, 12. B to B4 follows.

ILLUSTRATIVE GAME No. 5.

First five moves same as before.

White. Schallopp.	Black. Rankin.	White. Schallopp.	Black. Rankin.
6. B to K3	Q to K4 (*a*)	10. Kt × Kt	P × Kt
7. Q to Q3	Kt to B3	11. B × B	P × B
8. Kt to Q2	P to Q3	and White won.	
9. P to KB4	Q to K2		

(*a*) This move cannot be approved, as Black loses important time, which he ought to utilise to develop his pieces, especially as the Q will be driven away from K4 with further disadvantage.

ILLUSTRATIVE GAME No. 6.

First four moves as before.

White. Schallopp.	Black. Gunsberg.	White. Schallopp.	Black. Gunsberg.
5. Kt to Kt3 (*a*)	B to Kt3 (*b*)	12. P to K5 (*g*)	Kt to Kt sq.
6. P to QB4 (*c*)	P to Q3	13. P to KR3 (*h*)	Kt to R3
7. Kt to B3	Kt to B3	14. B to K3	Kt to B4 (*i*)
8. B to K2	Kt to K4 (*d*)	15. B × P	B to K3
9. P to B4 (*e*)	Kt(K4)toKt5	16. B × B	RP × B
10. P to QB5 (*f*)	P × P	17. K to B2	
11. Q × Q (ch)	K × Q	and White won.	

Notes.

(*a*) This form of attack is not new. White undoubtedly gains time, as the B must move now. It is questionable whether it will be of advantage to White later on to have both his Kt's on the Q side.

(*b*) White's intention would be thoroughly defeated if Black quietly retires this B to K2.

(*c*) This is a novelty and creates a weak point in Black's game on account of the threat of P to B5, which must prejudice and embarrass his play.

(*d*) A premature move. Black intended playing P to B3 to make room for his B, not thinking that White could venture on P to B4, which was always threatened, and then P to K5, attacking the QP, with a view to playing P to QB5.

(*e*) The advance of this P is the result of a deep and fine combination.

(*f*) This move gives White a good attack. The possibility of such a move occurring is a weakness which a player ought to avoid if possible, for one can never know how it may suddenly come into operation.

(*g*) The key move of the situation. Black cannot play Kt to Q2, the Kt on Kt5 being then deprived of protection. If he plays Kt to Q sq., the Kt has no move.

(*h*) Still more pressing on Black's game and with a view to playing B to K3, which would not only win back the P but also admit of Castling QR with an attack. The whole idea of giving up the P for the advantage of position belongs to the highest form of Chess.

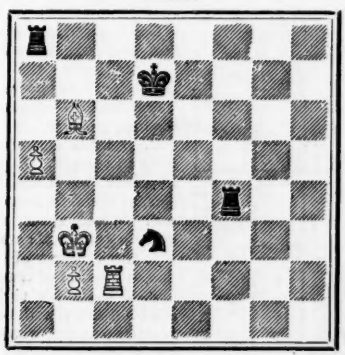
(*i*) The best. P to B5 is not good, on account of 13. B × B, if then P × Kt, 14. B × P (ch), &c.

ENDINGS FROM ACTUAL PLAY.

The following position occurred in the late tournament at Hamburg. It is most remarkable, as Black lost in spite of being a Rook ahead against two Pawns. Although, of course, the win is only accidental, yet White's play will be found instructive.

Berger.

Black.



White.

Schallopp.

The game continued with:—

R to Q2	R to B6	K to Kt7	R to B5
K to B4	R to B sq. (ch)	P to R6	R to Kt5
K to Kt5	R to KB4 (ch)	P to R7	Kt to B4 (ch)
K to R6	R to Q4	K to B sq.	R to R5
R to R2	K to B3	P to Kt4!	Kt to Q2 (*a*)
R to R6 (ch)	R to Q3	B to R5!	R to R7
R × R (ch)	K × R	K to Kt7 and wins.	

(*a*) A very curious draw could be forced by Black if on his 12th move instead of Kt to Q2 Black plays Kt to K3, then 13. B to R5, R × B! 14. P × R, Kt to B2. 15. K to Kt7, Kt to R sq. (best). 16. K × Kt, K to B2. 17. P to R6, K to B sq., stale mate.

Writing in the *Chemical News*, Mr. P. T. Austen and F. A. Wilber strongly advocate the use of alum for the purification of water, alleging that it not only clarifies but also removes disease germs and ptomaïnes. By adding 2 grains of alum to 60 litres of a rather turbid drinking water, a precipitate settled, and perfectly clear water was obtained after forty-eight hours. The dried precipitate contained per cent. C 16·50, H 2·02, N 0·77, ash 59·28, the latter consisting of small amounts of silica and alumina, large amounts of iron oxide, and considerable quantities of phosphoric acid. The clear water contained the merest trace of aluminium, and a further addition of alum caused no precipitation in it.

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Our Whist Column.

By "Five of Clubs."

In the following hand there is only one point of interest; but the whole game is instructive as showing how defensive play should be conducted. It will be observed that *A-B* hold excellent cards, having length in trumps and a long and strong suit:—

The Hands.

B { H. Q, Kn, 5, 4, 3. / S. Q, 8, 2. / D. 8, 6, 4. / C. Q, 7. }

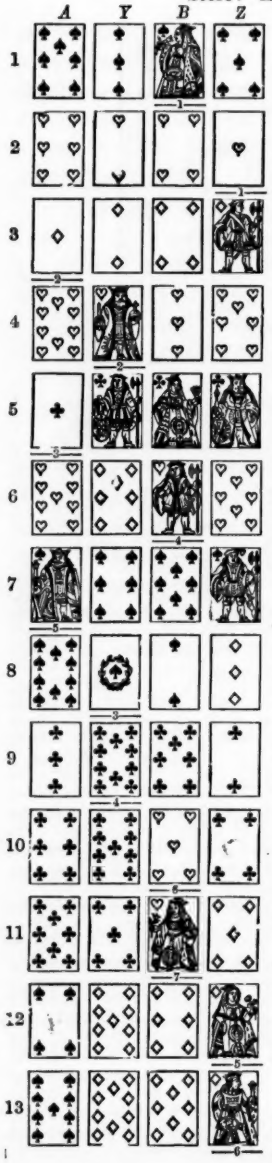
Y { H. K, 2. / S. A, 6, 3. / D. 10, 9, 7, 2. / C. Kn, 10, 9, 5. }

B / Y Z / *Tr. H. 8.* / A leads.

Z { A, 8, 7. H. / Kn, 5. S. / K, Q, Kn, 5, 3. D. / K, 4, 2. C. }

A { H. 10, 9, 6. / S. K, 10, 9, 7, 4. / D. A. / C. A, 8, 6, 3. }

Score:—*A-B*, 2; *Y-Z*, 0.



NOTES ON THE PLAY.

Card underlined takes the trick and card next below leads next.

1. *A* leads the penultimate, hereafter, I suppose, to be called "the card of uniformity," from his long suit.

2. *B* leads the card of uniformity in trumps. *Z* plays the Ace in order to make sure that a second round is not at once taken out. With a short suit he may be able to get a ruff; and in any case it is the interest of *Y-Z* to check the extraction of trumps.

3. *Z* leads the right card from his long suit; with only one small card the King would have been the correct card.

4. *A* returns the highest of two trumps left. *B* by dropping the Three shows that he had led from five trumps; for the Two has already fallen.

5. *Y* might perhaps preferably have returned his partner's Diamonds; but he has a re-entering card in Spades, and thought it best to see how Clubs lay. Luckily his Clubs are established at once.

7. If *Y* heads the Spade King, *B* must bring in his partner's long suit, unless it so chances that *B* has no Spades. As the score stands *Y* cannot afford to chance this; for if *B* can lead a Spade, *A-B* must make three tricks and the game. On the other hand, even if *B* has not a third Spade, all that will happen will be that *Y*'s Spade Ace will draw a trump from *A*, and it could not be better employed. For *Y* has the command in Clubs, and knows that *Z* has the command in Diamonds. *Y* risks nothing by keeping back the Ace, and ensures his own safety, in what proves to be the actual event.

8. *B*'s command in trumps is nullified; *A*'s long Spades can never now be brought in.

9, 10, 11, 12, 13. However *Y-Z* play, *B* can make only his long trumps. *Y-Z* lose the odd trick only, and the game is saved.

Ace-Lead. — A correspondent calls my attention to another Ace lead which is recognised or rather enjoined in his Club, viz.:—Ace, from Ace, Knave, Ten, Nine. This lead of the Ace is now so thoroughly out of date that I did not think it worth while to consider it. It is contrary to all Whist principles now in vogue, belonging to the old style of play which enjoined the making of all sure tricks in a suit, as a more important point than securing the command of the suit. By leading the nine, the proper lead, either King or Queen is surely brought down, possibly both. If King falls on the left of the leader, he can safely play the Ten on the return of the suit, as Queen does not lie on his left (unless a false card has been played); in any case there is a good chance of making two tricks safely and keeping the command. But if Ace is led originally, and the enemy hold King and Queen, command is lost at once. If the enemy do not hold King and Queen the Nine is obviously the best lead. Very few players in Europe now lead the Ace from Ace, Knave, Ten, Nine; the few that do are found among the last lingering fogies of the old school.

*** Through an oversight, the promise to give the solution to the problem which appeared on page 558 of our last volume has never been fulfilled. The solution, however, will be published in our next issue, together with the names of those who may have solved the problem.

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